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EDITORIALS

Cooperative Thought

THE profession of agricultural engineering owes its existence to definite requirements for engineering assistance advanced by the different recognized branches of agriculture. Viewed from such an angle it is therefore a purely service profession, the function of which is to assist in the improvement of the different agricultural practices to the fullest extent. Obviously then, the agricultural engineer must be keenly alive to those particular features of agricultural problems wherein the intelligent application of engineering principles and skill may result in the greatest and most timely assistance.

It is for this reason that recognized agricultural engineering curricula include courses on the general principles of recognized branches of agriculture. Obviously, however, such agricultural courses do not fully inform the prospective engineer as to the details of all agricultural practices and their attendant problems. Their purpose is rather to show where such problems may originate and to indicate in a very general way something of their probable nature.

Too many agricultural engineers do not fully appreciate this. Many feel capable of handling problems or meeting requirements, without inquiry into the details of the agricultural practices advancing them, beyond their own limited knowledge thereof. This frequently results in blind attempts at the application of known engineering principles to agricultural problems, the elementary requirements of which are hazy, to say the least, in the mind of the engineer. Such practices become even more questionable when it is considered that agricultural specialists themselves do not have the details of their requirements for engineering assistance clearly in mind.

It is the duty of the agricultural engineer to use engineering principles to meet such requirements. If available engineering principles are not applicable, it is his duty to modify them with scientific accuracy until they are applicable. If necessary, it is up to him to develop new engineering principles to meet the conditions of each specific requirement.

To do these things with precision and scientific accuracy the engineer must first know, in detail, exactly what is desired of him in order that he may make an intelligent application of his knowledge and skill. If his available knowledge is sufficient, it is all the more important that he have a definite, detailed requirement clearly in mind to permit him to determine exactly what it is he wishes to know before he starts in to find it out.

This does not mean that the agricultural engineer should become a specialist in all the recognized branches of agriculture. It does mean, however, that the agricultural engineer, whether in extension work, consulting practice, or research, should enter into cooperative thought with specialists in those branches of agriculture requiring engineering assistance with the purpose of arriving at a meeting of minds as to exactly what is required of the engineer, as a basis for his action.

For example, the preliminary analysis of a project on poultry house ventilation, recently received, indicated that the engineer realized the impracticability of attempting to supply a well-ventilated poultry house without first having an exact knowledge of the ventilation requirements of poultry under actual living conditions. A session of cooperative thought with the poultry husbandman and the chemist apparently revealed the fact that the exact ventilation requirements of poultry under actual living conditions of the kind in question were not known. The procedure adopted was planned to supply this deficiency in the knowledge of the poultryman and thus to provide an accurate basis for the operations of the engineer in actually supplying the properly ventilated poultry house.

Thus the agricultural engineer, by entering into constructive cooperative thought with the specialist in any branch of agriculture, which offers him a problem, can insure definite purpose, exact direction, and accuracy in his work. Cooperative thinking may also often bring out deficiencies in the available knowledge of recognized branches of agriculture and indicate wherein further elucidation thereof is necessary before a definite clear-cut requirement for assistance can be presented to the engineer. In such a case the opportunity offered the engineer for an exercise of his ingenuity in assisting the agriculturist to supply the deficiency is one which has helped to build up the tradition regarding the resourcefulness of the engineer in an emergency.

R. W. TRULLINGER

Why They're Leaders

IN any organization—in fact, in almost any line of human activity—will be found those who naturally and without conscious effort on their part are looked upon by their fellows as the leaders. Why are they the leaders?

They are the leaders because they have put their shoulders to the wheel ad pushed. By hard work and self-sacrifice they have helped to advance the cause. The progress made is the fruit of their labors.

A technical society represents a cooperative effort of the members of a profession to advance their individual interests by first advancing those interests common to all. A cooperative effort means one in which all unite in putting something into it. Naturally those who contribute most to the effort will not only reap the greatest rewards personally, but they will automatically be looked upon by the rank and file as the leaders.

Taking the American Society of Agricultural Engineers as an example, the men who have taken the keenest interest in Society affairs, who have contributed most in the way of preparing papers and taking active part in committee work, and who have been most regular in attendance at Society meetings, are counted as leaders in the organization—and that is why they are leaders. Furthermore, they are almost invariably the "leaders" in earning power.

This is not an argument that one should aspire to leadership; rather should he aspire to improving his own circumstances through contributing to the general advancement of his profession.

There is no limit to the number of "leaders" the activities of the American Society of Agricultural Engineers will accommodate. The harvest truly is great that is waiting to be garnered, but the laborers indeed are too few. There is a great number of special lines of work that need the fostering which an organization like A. S. A. E. can give. There is abundant opportunity for Society members to undertake these special lines of work and thereby contribute to the advancement of their profession and to the increasing of their own knowledge, ability and earning power. And so be counted among the leaders.

RAYMOND OLNEY

How Far Should Farm Houses Be Standardized *

By Walter G. Ward

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THE subject of farm houses has been discussed before this Society in previous years, the Transactions for 1915 and 1916 both carrying papers pertaining to this important unit of the farm structures group. In one of the papers may be found the statement: "The house differs from all other farm equipment in that it cannot and it should not be standardized in the accepted meaning of the term."

This statement will hold if we are to understand that standardization means exact duplication, particularly in the design of the exterior. On the other hand, there are many factors which enter into the planning and construction of farm houses, which, due to the lack of recognized standards of type, quality, and dimension, are often handled in a way which results in disappointment to the farm family. It is the purpose of this paper to try to develop some thoughts on the extent to which standardization might be applied to farm houses.

The advantages of standardized plans for the other farm buildings are quite generally recognized, but even here a number of factors enter into the problem, so that no one plan would be suitable for a building of a particular kind in all sections of the country. Climatic conditions, size of farm, type of farming, and size of herd or flock are all factors influencing the plan of the building. Similar factors enter into the problem of planning the farm house, and insofar as the utilitarian features are concerned will lend themselves to standardization. In contrast with this the aesthetic features allow opportunity for individuality, which should be encouraged.

Perhaps a code of minimum requirements would accomplish much the same as standardization, except there are excesses which are quite as serious as deficiencies.

A study has been made of a number of farm house plans to determine wherein they included like features which might be recognized as standards. For this purpose a number of arbitrarily chosen headings are used so that the information might be shown in chart form.

Fifty farm house plans were analyzed in this study. Twenty-five of these were plans which I prepared for houses on Kansas farms and the other twenty-five were from other states, including Nebraska, Iowa, Indiana, Minnesota, and Mississippi, and some from the U. S. Department of Agriculture. While the number of plans analyzed is too small to be conclusive concerning average values, the plans used were chosen as representative examples of bona fide farm houses. No houses designed for large country estates were used.

If a continued study of well-prepared farm-house plans shows a similar range of values, it would seem practical to establish a standard to at least be recognized as good practice. Let us consider for a moment the window area. Looking at the charts we find the rooms averaging 13.07 to 19.0 per cent of their floor area, with a total average of 15.52 per cent, or, if based on room averages, 16.18 per cent. The bathroom might be regarded separately, which would increase the room averages for the balance of the house to 16.3 per cent. This is approximately one-sixth, which would be a convenient figure to use, just as school house designers provide glass equal to one-fifth of the floor areas of classrooms.

Details of construction will always make slight variations necessary in the story heights, but from the data on the charts it would appear that a basement of 7½ feet, a first story of 9 feet, and a second story of 8 feet would approach the average practice. The number of doors opening into the room is perhaps of minor interest, except in the kitchen where an excess of doors makes it difficult to plan a convenient arrangement. Where more than three doors are provided it is almost necessary to increase the size of the room.

It is probable that the sizes for the living room, dining room, and bedrooms should not be held to a uniform scale, after certain minimum requirements are met. For example, a dining room narrower than eleven feet is not convenient, but there would be no objection to a greater width.

Numerous other details such as width and steepness of stairways, number and size of flues, thickness of walls of different materials, pitch of roofs, and grading of basement floors, are troublesome matters for those unaccustomed to building, and a recognized guide on the subject would save many costly mistakes.

*Eighteenth annual meeting paper.

Many utilitarian features of farm house design lend themselves to standardization, a thing that agricultural engineers should foster at every opportunity. In this connection attention should be given to the preparation of a rural building code which is so much needed.

ANALYSIS OF 50 FARM HOUSE PLANS

		Height	Size Area Sq. Ft.	Glass Area Sq. Ft.	% of Glass To Floor Area	No. of Bedrooms	First Floor Height	Second Floor Height	Basement Height
House	Ave.		1156.2			3.19	8'-10.8"	8'-3.6"	7'-1.2"
	Max.		1728			5	9'-6"	8'-6"	8'-0"
	Min.		638			2	8'-5"	8'-10"	7'-0"
	Ave.		1034.8			2.96	8'-8.7"	8'-10.7"	7'-3.6"
	Max.		2572			6	11'-0"	9'-0"	8'-0"
	Min.		576			1	8'-2"	7'-10"	7'-0"
	Average		1076.1			3.07	8'-9.7"	8'-1.1"	7'-2.6"
Bathroom	Ave.		52.87	6.06	11.59				
	Max.		86.0	14.0	16.3				
	Min.		33.7	2.8	5.8				
	Ave.		52.86	7.79	14.85				
	Max.		93.7	21.3	28.1				
	Min.		35.0	4.0	8.2				
	Average		52.865	6.927	13.07				
Kitchen	Ave.	8'-10.6"	119.64	15.86	13.56	2.9.6	3.15		
	Max.	9'-6"	148.0	23.0	21.0		4		
	Min.	8'-3"	96.0	11.9	8.8		2		
	Ave.	8'-3"	123.13	21.92	17.07	31.33	3.15		
	Max.	11'-0"	167.2	34.66	29.8		5		
	Min.	8'-2"	111.6	10.24	8.75		2		
	Average	8'-9.9"	124.36	16.9	13.52	30.39	3.15		
Combined Kitchen Dining Room	Ave.	None							
	Max.								
	Min.								
	Ave.	8'-6"	234.06	33.78	14.41				
	Max.	8'-6"	290.0	50.3	17.4				
	Min.	8'-6"	193.0	26.0	10.55				
	Average	8'-6"	234.06	33.75	14.41				

ANALYSIS OF 50 FARM HOUSE PLANS.

		Height	Size Area Sq. Ft.	Glass Area Sq. Ft.	% of Glass To Floor Area	Wall Space	
Living Room	Ave.	8'-10.55"	254.3	39.11	15.5	30.6	
	Max.	9'-6"	360.0	60.1	23.3	41.0	
	Min.	8'-5"	189.0	14.0	10.1	15.0	
	Ave.	8'-3.1"	217.56	36.75	16.23	27.74	
	Max.	11'-0"	428.0	73.3	27.6	41.5	
	Min.	8'-2"	123.5	20.2	12.8	14.0	
	Average	8'-9.6"	235.93	38.93	16.67	29.17	
Dining Room	Ave	8'-10.55"	194.37	31.97	17.01		
	Max	9'-6"	270.0	49.2	23.5		
	Min	8'-3"	131.0	21.0	11.65		
	Ave	8'-10"	185.14	28.36	15.33		
	Max	11'-0"	286.5	49.5	29.2		
	Min	8'-2"	114.0	16.0	7.3		
	Average	8'-10.28	183.75	30.26	16.47		
Combined Living Dining Room	Ave	8'-8.5"	312.0	52.85	17.35	2 Rooms	
	Max	9'-0"	366.0	54.7	19.7		
	Min	8'-5"	256.0	51.0	13.0		
	Ave	8'-8.75"	223.17	42.21	19.45	4 Rooms	
	Max	9'-0"	310.5	56.4	24.9		
	Min	8'-3"	143.7	34.66	15.5		
	Average	8'-7.66"	232.76	43.73	18.73		

Of the 50 houses, 17 had sleeping porches; 3 had breakfast nooks; 7 had sewing rooms; 2 had sunrooms; 3 had parlors or sitting rooms; 14 had offices or dens; and 17 had washrooms.

11 were 2 stories; 22 were 1½ stories; and 17 were 1 story.

ANALYSIS OF 50 FARM HOUSE PLANS.

		Height	Size Area Sq. Ft.	Glass Area Sq. Ft.	% of Glass To Floor Area	Closet Area	
Bedroom No. 1	Ave.	8'-4.04"	169.4	23.54	13.85	37.6	
	Max.	9'-6"	288.0	36.0	27.5	130.0	
	Min.	8'-0"	112.5	14.0	7.9	10.3	
	Ave.	8'-4.0"	154.46	24.81	16.56	14.73	
	Max.	9'-0"	263.5	39.3	20.5	36.0	
	Min.	8'-0"	80.6	18.0	9.92	7.8	
	Average	8'-4.02"	161.9	24.17	15.2	27.6	
Bedroom No. 2	Ave.	8'-4.7"	143.3	21.26	14.96	36.43	
	Max.	9'-6"	235.0	32.0	27.5	1500	
	Min.	8'-0"	110.0	14.45	9.04	8.0	
	Ave.	8'-3.6"	135.4	22.63	17.01	14.19	2.2 Rooms
	Max.	9'-0"	247.0	54.0	29.5	38.7	
	Min.	8'-0"	80.6	13.0	9.2	4.3	
	Average	8'-4.15"	139.36	21.24	15.26	25.29	
Bedroom No. 3	Ave.	8'-6.16"	131.32	20.43	15.92	23.96	1.82 Rooms
	Max.	9'-6"	181.2	26.67	21.5	71.25	
	Min.	8'-10"	99.0	15.7	11.3	3.75	
	Ave.	8'-3.3"	126.29	21.67	17.36	12.44	1.5 Rooms
	Max.	9'-0"	217.0	34.5	28.2	24.0	
	Min.	7'-10"	80.0	13.0	9.1	8.75	
	Average	8'-4.73"	122.9	21.09	16.64	18.2	
Bedroom No. 4	Ave.		113.14	20.86	17.98	23.17	1.36 Rooms
	Max.		163.0	26.67	26.0	56.5	
	Min.		80.0	13.33	13.06	8.75	
	Ave.		106.55	21.66	20.63	11.05	0.9 Rooms
	Max.		142.0	35.4	26.7	15.0	
	Min.		63.0	11.5	12.0	4.63	
	Average		111.9	21.0	19.1	18.53	

The foregoing features might all be classed as problems in planning

Many construction features might be studied in a similar manner, to ascertain the common practice. Tables showing the recommended spacing and spans for floor joists, rafters, studding, etc., would be helpful to the farmer-builder. Here, however, the problem is much the same as for city dwellings, except there are no building codes to serve as a check on unsafe and unsanitary construction.

While unwise efforts to economize account for many of the unsatisfactory features to be found in farm houses, more available information and a practical building code or set of standards would do much to improve the situation. The American Society of Agricultural Engineers might well undertake the development of such a code. It might require several years to complete it, although much of the work would represent a compilation and adaption of material now available in other forms. "Recommended Minimum Requirements for Small Dwelling Construction," published by the U. S. Department of Commerce; the building code recommended by the national board of fire underwriters; the national electrical code by the same body; Kansas Engineering Experiment Station Bulletin No. 7, "The Farmhouse Improved," by W. A. Atherton; bulletins from other stations; many city building ordinances; and structural handbooks would furnish a large part of the information which should be incorporated in a work of this kind. A practical code of rural building construction might attain legal standing, but even without that it should ultimately serve as a recognized guide, and a contract for the erection of farm buildings in accordance with an A. S. A. E. Code would insure a better class of structures than is to be found on the average farm today.

A brief contract and skeleton specification form would doubtless assist in avoiding many of the misunderstandings between the contractor and farmer, and might be published as a part of the code, or as a separate document made available through some agency such as the county farm bureau, the lumber dealer, or both. I believe the American Society of Agricultural Engineers would be taking a forward step in authorizing the farm structures group to begin the preparation of a rural building code.

Summary of the National Farm Power Survey

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the tractor, as it is now designed, does not entirely displace horse power on most farms, and the horses that are necessarily kept do only about half as much work as before the tractor was purchased. This results in the cost per horsepower-hour of the horse labor being materially increased, and while under average conditions tractor power costs only about half that of horses, the total tractor bill is actually increased instead of being decreased. Plate XV shows graphically the cost of horse and tractor power for varying amounts used annually and the average cost of horse power when used in conjunction with tractor power.

In choosing any type of power for farm use, many factors have a bearing, chief of which are as follows: Total cost per horsepower-hour developed; speed of operation; attention required while in operation; care required while not in use; and convenience of power when wanted. For the small job requiring little power, convenience is the first consideration, but for the larger jobs economy of operation will be the deciding factor. The values given in Plate XIV for the cost of the various kinds of power may be used as a guide in considering what rates must be given if electricity is to compete with the kinds of power now generally used in farm work. Local conditions and varying costs of fuel and feed will of course have an influence on the values given.

New Developments in Salvaged War Explosives

(Continued from page 175)

powder, must be avoided. When using cap or fuse the primer should be made so that the fuse does not come in contact with the powder. The cap only should enter the cartridge.

Tests made with pyrotol show that for rock work using the mud capping method, pyrotol would be about equal to sodatol, pound for pound. For stump blasting the tests showed that pyrotol proved to have nearly the equivalent strength of sodatol, pound for pound.

Pyrotol will be put up in double-dipped standard sized paraffined cartridges. This explosive is more bulky than sodatol, a 1¼-by-8-inch cartridge weighing a little more than five ounces. Pyrotol will be distributed in fifty-pound boxes, containing about one hundred fifty cartridges per box, or about one hundred cartridges per hundred pounds of pyrotol.

Bids covering the preparation and cartridging of pyrotol were to be received by the U. S. Bureau of Public Roads, Washington, D. C., July 10. Until these bids are received it will be impossible to make any estimate of the delivered cost of this explosive at parts throughout the United States. It is believed that the cost will be sufficiently low to allow a considerable saving over the cost of commercial explosives.

The Manless Plow *

By J. B. Davidson

Mem. A. S. A. E. Professor of Agricultural Engineering, Iowa State College

THE manless plow as described in this brief paper reports a study into the practicability of an automatic plow or field machine which will operate with little personal attention. For some time the term "automatic plow" was used to describe the machine, but it was learned by experience that this term did not carry so clearly the primary idea of the machine as the term "manless plow."

Plowing is the most important field operation in the production of agricultural crops and involves a large amount of labor. It is easy to explain why plowing should be selected for a study of the practicability of an automatic field machine. If it is assumed that one-half of the total area of improved land in the United States (which is given as 503,730,000 acres) is plowed each year and the cost of plowing is $2.50 per acre, the annual cost of plowing each year is $628,841,000. Under present methods from 20 to 25 per cent of the cost is labor, or approximately $150,000,000. There are few farm operations involving such a large expenditure of labor.

Many automatic operations have been developed in the manufacturing industry. The making of tin cans is a good example of a complex automatic operation, where a can is completely fabricated, assembled, and tested without manual labor. It is true that much automatic machinery, or semi-automatic at least, has been developed in agriculture, the self-binder being a notable example. As a mechanical problem, the formation of a sheaf from loose grain and the tying of a band around the same is an operation of considerable complexity which has been carried out very successfully.

Two different students have made a study of the automatic plow at Iowa State College. The first study was made by Darrell B. Lucas during the college year of 1922-23, and the second by Edward D. Gordon during the year 1923-24. These men have had the assistance of E. V. Collins and myself. The studies consisted of review on previous efforts as far as it was possible to secure information concerning the same and to design and construct actual machines.

The manless plow designed and built by Mr. Lucas consists of a two-wheel tractor, with a four-horsepower, single-cylinder engine to furnish the power. Right and left-hand plow bottoms were attached to the frame with their beams opposite and nearly at a right angle to the tractor axle and so placed that while one plow was in the ground the other would be carried above the surface of the ground. In order to facilitate the construction, parts of other machines were used as far as possible in the construction of the plow.

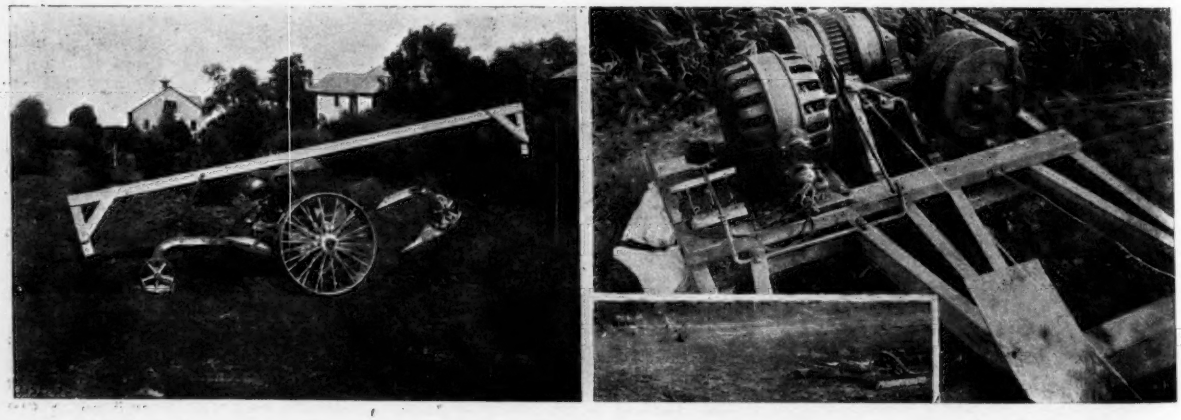
In operation the outfit is steered by hand for an initial furrow, after which the initial furrow serves as a means of guiding the plow. The success of this plan was fully demonstrated. A driving wheel will leave a furrow wall only under rare conditions. The furrow does not need to be particularly deep in order to control the plow in this manner.

The machine travels back and forth across the field in shuttle style. A reversing arm or antenna hangs over the tractor, extending out some distance beyond the machine in each direction. This reversing arm upon coming in contact with a fence or other obstruction is pushed back to a point where spring action comes into play and reverses the direction of the drivers. The reaction immediately lifts the plow in service out of the ground and swings the opposite plow down ready to enter the soil. This action takes place quite smoothly and positively.

One problem in connection with the operation of the machine is that of moving the tractor over across the direction of travel the width of one furrow each time the machine is reversed. This was accomplished by having the driving wheel on the plowed ground side of the tractor make a part of a revolution with the driver on the unplowed land, serving as a pivot. The first machine had an alternating action of these drivers, that is, the drive-wheel on the plowed ground side made a part of a revolution after which both would begin to move forward. The travel of the part of the revolution that the drivers make in this operation is so regulated that the machine would be moved over the width of one furrow. It was found by experiment that a more simple action answered the requirement.

To put a machine of this kind into actual service, it is obvious that certain safety devices are necessary. For instance, if the tractor should leave the furrow provisions must be made for stopping the engine after a few feet of

*Eighteenth annual meeting paper.



(Left) The Lucas manless plow during reversal from contact with a fence. (Right) The motor skid and cable reels of the Gordon automatic electric plowing outfit; the insert shows the complete outfit set up for operation

travel. Mr. Collins has worked out such a device consisting of a ground wheel coming into contact with the ground as soon as the tractor leaves the furrow and which after a few feet of travel cuts off the ignition thus stopping the motor. Also some device is needed for stopping the machine providing an obstacle is encountered from the side of the machine. This can be a very simple device for cutting off ignition.

The machine designed and built by Mr. Gordon was a result of a study of a machine with a stationary motor and using cables. Mr. Gordon used an electric motor and his work was in part a study into the practicability of the use of electrical power for field work. To those who are familiar with cable machinery the advantages and disadvantages of the method are clear. The principal advantage lies in the higher efficiency in the transmission of the power of the motor to the implement. In case of the tractor it is not far from average practice when one-third of the power of the motor is delivered to the implement. J. R. Bond, an English writer, states that it is practicable to deliver two-thirds of the power of the motor to the implement with cables or, in other words, the cable plan would be 100 per cent advantage. The cable plan of cultivation would be particularly well adapted to the use of electrical power.

The machine as built by Mr. Gordon consists of a skid carrying an electric motor and reels for the main cable used in drawing the implement back and forth across the field, an anchor skid upon the opposite side of the field carrying a pulley, reels on the motor skid for moving the power skid and an anchor skid forward at the proper time, reversing mechanism to the motor and an intermittent drive to the reels for moving the skids.

The machanism for moving the power and anchor skids was one of the most ingenius parts of the machine. This device would move the skids alternately every time the motor was reversed by taking in cables attached to another at the corners of the fields. The skids were held in place by one runner following a furrow.

There is one important feature of the economics of the plan of automatic operation which should not be overlooked. A very small machine costing little money will take care of a large area. If such a plan is practicable there is no reason why an outfit of this kind should not operate continually for twenty-four hours a day.

Digressing from the technical discussion of these experiments, it may not be out of place to report that among other results the experiment furnished a rather interesting cross-section of human optimism. Nothing in my experience has ever produced such wide range reaction; from the pessimist, who could not conceive of a field operation without manual control under any condition however favorable, to the enthusiast who becomes almost carried away with the possibilities of the idea.

In the beginning we considered these only problems for advanced students whose initiative and originality were to be tested. The problems were satisfactory from this standpoint, but on the other hand the actual demonstration of these experimental machines rather leads us to believe that we may see developments of this kind in the near future. An automatic field machine traveling in a spiral about a central anchor in circular fields is now being manufactured. We are inclined to think that under favorable conditions we may see automatic machines for rectangular fields.

New Developments in Salvaged War Explosives*

By W. A. Rowlands

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FIVE years ago the first attempt to cartridge and use a surplus war explosive for agricultural purposes was made in the United States by the Wisconsin College of Agriculture.

Small quantities of TNT and grenite were distributed by the government in bulk to Indians.

Since 1919 more than fifty million pounds of cartridged TNT, grenade powder, picric acid, and sodatol have been distributed throughout the United States. This distribution has increased generally from a few hundred thousand pounds a season up to nearly 14½ million pounds of sodatol the past nine months.

The supply of sodatol at prices one-third or less than commercial dynamites was exhausted, and experiments were conducted under the direction of the division of agricultural engineering, of the U. S. Department of Agriculture, cooperating with the U. S. Bureau of Mines and the Wisconsin College of Agriculture. These experiments were to work out a way to utilize large quantities of surplus war smokeless powder, largely nitrocellulose.

Smokeless powder is a low explosive and in that condition is of no value in agricultural blasting work. It is a propellant and as such is used in rifles and cannon in propelling projectiles.

By an invention known as the Hunter process, smokeless powder is changed in a form having action similar to dynamite. In its ordinary form smokeless powder is not exploded by a detonating cap but is ignited by a spit of flame. This burning takes place so slowly that no work would be done in blasting stumps, rocks, or ditches. When finely ground, however, this material changes in nature and becomes sensitive to detonation. This fact, the basis of the Hunter patent, makes possible the preparation of an explosive for agricultural use. The grinding process must be carried on with special machines and under water. While the explosive in this condition gives excellent results in blasting operations, it cannot be economically and commercially cartridged. It is somewhat too fast, that is, it has too great a shattering effect. To obviate this difficulty other materials are incorporated, chiefly sodium nitrate.

',Pyrotol" is the name given to this new formulae. It is a dark straw-colored crystalline substance. It is a free running powder but much less so than picric acid. Pyrotol is going to be a safe explosive to handle and use. Complete detonation in all cases has been made with a standard No. 6 common or electric blasting cap.

Ordinary moisture conditions met with in agricultural blasting operations have no effect on pyrotol. Cartridges properly packed and dipped can be safely put in moist bore holes the same as ordinary dynamite and sodatol.

Pyrotol is not affected by ordinary temperatures and is practically a non-freezing explosive. No physiological effects have been noticed through the continued handling of the powder. No dynamite headache is produced, and no coloring of hands or clothing has been observed.

Pyrotol has almost exactly the same speed and strength by weight as sodatol. Sodatol gave such good satisfaction throughout the country generally that an explosive should be made having as nearly as possible the same properties.

Unlike sodatol, pyrotol is an inflammable explosive and precautions must be taken to insure against burning the powder. Only a good quality of fuse, a slow and cool-burning fuse, should be used. The so-called lacing method of priming, which permits the fuse to go through the

(Continued on page 173)

*Eighteenth annual meeting paper.

Summary of the National Farm Power Survey*

By C. D. Kinsman

Mem. A. S. A. E. Senior Agricultural Engineer, U. S. Department of Agriculture

THE purpose of the farm power survey that has been under way the past year by the U. S. Department of Agriculture has been to assemble all available data on the sources and uses of power on farms in the United States. As outlined in the beginning, the survey was to include the collecting of all data available on the number, distribution, sizes and types of farms; the amounts and kind of livestock kept; the kinds of crops raised with the average and yields of each; the number and distribution of work animals; various kinds of mechanical power units, and the number of agricultural workers, both regularly and intermittently employed.

The total amount of each kind of power used was then to be determined; and also the amount required for each farm operation, the production of each principal commodity, and for the operation of the various types and sizes of farms.

A large amount of material bearing on the subject has been assembled and has been analyzed according to the above headings. Much of the material collected is based on census figures and can be considered very reliable; while the figures on power requirements of operations and commodities which have been computed from a rather limited amount of data must be considered only approximately correct. So many factors enter into the determination of their values that a much larger amount of experimental data will be necessary before they can be accurately determined for all conditions.

The importance of the use of farm power as a problem for study may be suggested by the following information brought out in the survey: More primary power is used by agriculture at the present time than in any other industry with the exception of transportation. All manufacturing industry combined has only about half as much power available as has agriculture. The cost of power on farms in the United States at present values is about three billions of dollars annually. However, by the use of this power, together with modern labor-saving equipment, the American farmer is enabled to increase his production per man by at least three times over what is possible with other methods seventy-five years ago.

That an extremely close relationship exists between the amount of power and machinery used per worker and the volume of production is conclusively shown by the accompanying plates.

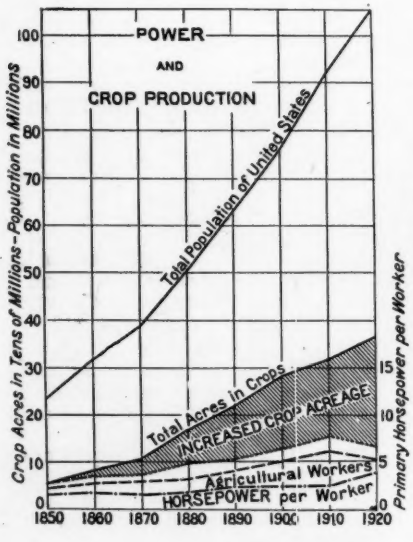
In Plate I is shown the increased crop acreage that has taken place in the United States since 1850. The shaded portion shows the increase that may be attributed to the increased production per worker and is without doubt almost entirely due to the greater use of power and machinery.

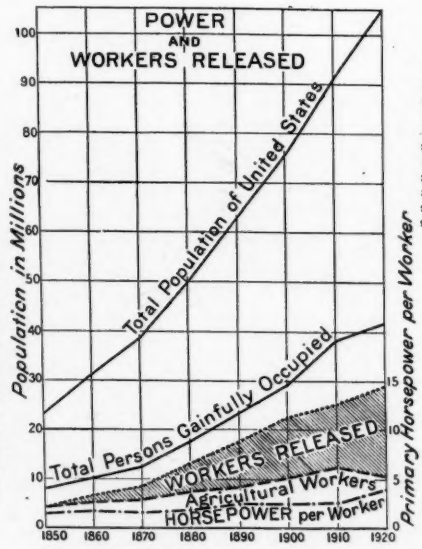
Plate II shows the proportion of workers that have been released from agriculture due to the increased production per worker. Since food is the primary need of mankind, agriculture is the basic industry. In early times it required practically the entire efforts of the human race to provide sufficient food and shelter to sustain life, and it has been only by increasing the efficiency of those engaged in producing food that others have been released to provide the comforts and luxuries that go to determine our standard of living. It has been estimated that at the beginning of the last century it required over ninety per cent of the workers of this country to produce sufficient food for the nation, while at present about twenty-five per cent of those gainfully employed, with the aid of power and modern machinery, are able to produce not only enough for our own people but also a considerable surplus for export.

Plates III and IV show how closely the relationship exists at the present time in the various states and in European countries between the power available and the production per worker. Plate V shows that the same relation exists between horsepower-hours utilized and the volume of production.

In Plate VI is shown a comparison between agricultural and other industries based on 1919 values. Several of the weak points of the agricultural industry are brought out in this chart. While the value of the product of the agricul-

*Eighteenth annual meeting paper.





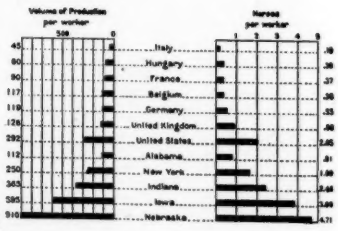
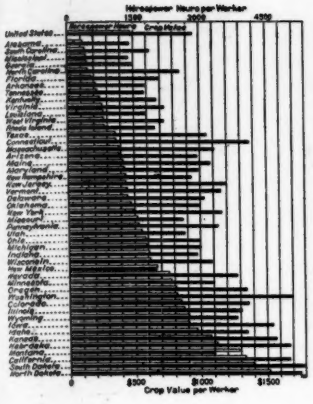
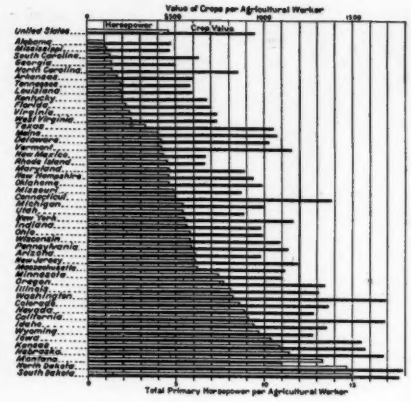


Plate I. (Extreme left) Increase in crop acreage in the United States, 1850 to 1920

Plate II. (Left) Workers released from agriculture in the United States during the period, 1850 to 1920

Plate III. (Above) Relation between power and production in European countries and the United States





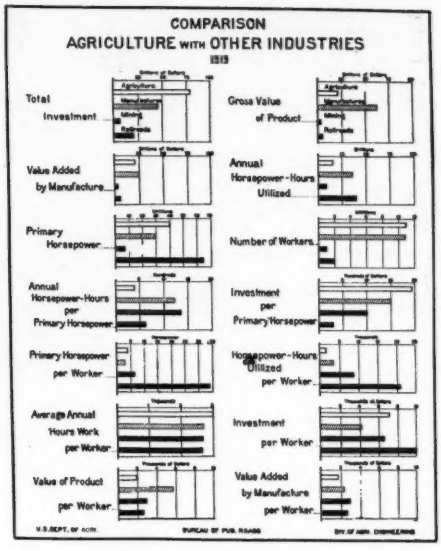


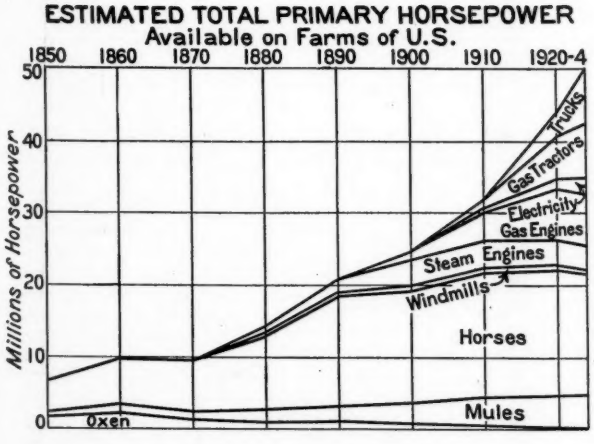
Plate IV. (Above, right) Relation between horsepower and crop production, or value of crops, per agricultural worker by states

Plate V. (Above, left) Relation between horsepower-hours and crop production, or value of crops, per agricultural worker by states

Plate VI. (Right) Comparison of agriculture with other industries

TABLE I.—APPROXIMATE PRIMARY HORSEPOWER AND HORSEPOWER-HOURS UTILIZED ON FARMS IN THE UNITED STATES ANNUALLY

Kind of Power	Total Units or Installations	Total Primary Horsepower		Average Horsepower-Hours Per Primary Horsepower	Total Horsepower-hours Developed Annually	
Work animals	21,868,000	21,660,000	44.1%	447	9,690,000,000	61.4%
Gas tractors						
(a) Drawbar	400,000	4,000,000		225	900,000,000	5.7%
(b) Belts		8,000,000	16.3%	79	632,000,000	4.0%
Steam tractors	50,000	2,500,000	5.1%	400	1,000,000,000	6.3%
Motor trucks	356,000	7,120,000	14.5%	80	570,000,000	3.6%
Stationary engines						
(a) Large	20,000	500,000	1.0%	892	446,000,000	2.8%
(b) Small	2,480,000	6,820,000	13.8%	220	1,500,000,000	9.5%
Windmills	1,000,000	500,000	1.0%	400	200,000,000	1.3%
Electricity						
(a) Individual plants	300,000	900,000	1.8%	167	150,000,000	1.0%
(b) Central stations (small)	170,000	680,000	1.4%	143	100,000,000	0.6%
(c) Central stations (large)	20,000	500,000	1.0%	1200	600,000,000	3.8%
TOTAL		49,180,000	100%	320	15,788,000,000	100%



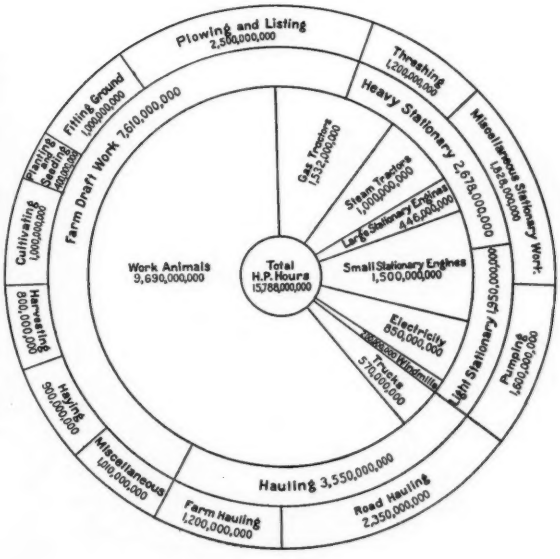


Plate VII. (Above) Estimated total primary horsepower on farms of the United States, 1850 to 1924

Plate VIII. (Right) The total horsepower-hours available on farms and how it is utilized

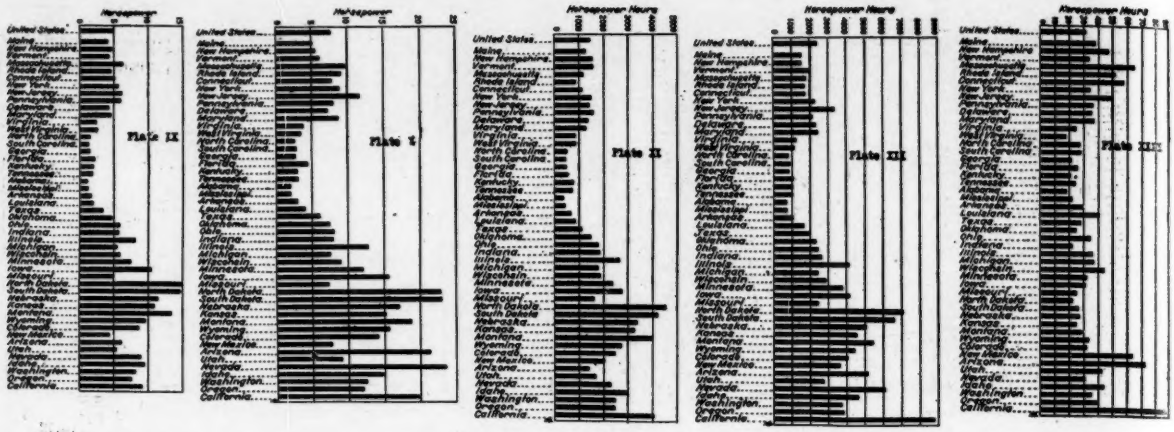


Plate IX. Average primary horsepower per worker. Plate X. Average primary horsepower per average-size farm. Plate XI. Average total horsepower-hours per worker per year. Plate X II. Average total horsepower-hours per average size farm per year. Plate XIII. Average total horsepower-hours per improv ed acre per year

TABLE II.—APPROXIMATE POWER REQUIRED FOR FARM OPERATIONS

Field Operations

Operation	Conditions	Draft-pounds per foot in width covered	Horse-power-hours per acre
Plowing 6 inches deep	Sandy loam	200-400	4.5- 9
" " "	Sandy clay loam	350-500	8-11
" " "	Clay loam	400-600	9-13
" " "	Heavy clay	600-1000	13-22
" " "	Gumbo	1000-1500	22-33
Pegtooth harrow	Average	15-60	0.3- 1.3
Spring tooth harrow	"	25-70	0.5- 1.5
Disk harrow (single)	Clay loam	70-100	1.5- 2.2
" " "	Heavy clay	100-150	2.2- 3.3
Land roller	Average soil	20-80	0.4- 2.0
Drilling grain	" "	20-80	0.4- 1.8
Mowing	" "	35-70	0.75- 1.5
Raking (dump rake)	" "	15-25	0.3- 0.6
Raking (side delivery)	" "	20-40	0.4- 0.8
Hay loader (and wagon)	" "	50-100	1.1- 2.2
Grain binder	" "	60-100	1.3- 2.2
Grain header	" "	50-80	1.1- 1.8
Header-thresher	" "	90-180	2.0- 4.0
		Draft per row	
Corn Planter	Average soil	130-300	1.0- 2.5
Corn cultivator	" "	130-300	1.0- 2.5
Corn Binder	" "	300-600	2.5- 5.0
Corn Picker	" "	1000-1800	7.5-14.0
Potato digger	" "	600-1000	5.0- 7.5
Stalk cutter	" "	130-250	1.0- 2.0

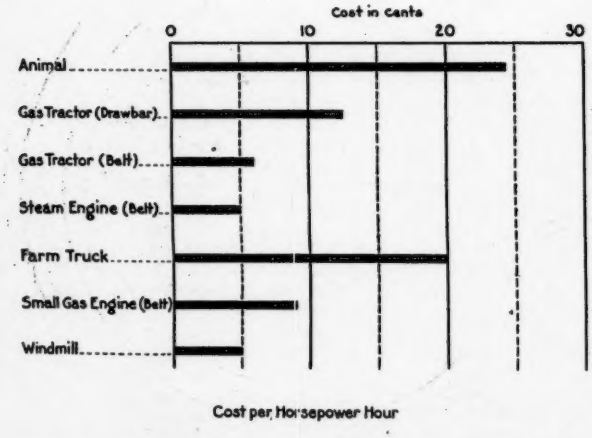
TABLE III.—APPROXIMATE POWER REQUIRED FOR FARM OPERATIONS

Hauling

Road Bed	Draft per ton (pounds) Gross load	Horse-power-Hours per ton mile Gross load
Concrete pavement	20-30	0.05-0.08
Water bound macadam	60-80	0.15-0.20
Gravel (good condition)	80-100	0.20-0.25
Earth (dry and firm)	80-100	0.20-0.25
Hay stubble (dry)	100-200	0.25-0.50
Corn "	150-300	0.40-0.80
Plowed ground	300-500	0.80-1.30

Belt Operations

Operation	Unit	Horse-power-Hours per unit
Threshing wheat or rye	100 bu.	20-40
Threshing oats or barley	100 bu.	10-25
Threshing peas or beans	100 bu.	20-40
Hulling alfalfa or clover	100 bu.	100-300
Shredding corn	100 bu.	20-40
Shelling corn	100 bu.	4-8
Cleanjng grain	100 bu.	2-10
Elevating grain	100 bu.	0.2-0.5
Grinding grain	100 bu.	10-30
Cutting silage or feed	ton	0.9-2.5
Baling hay or straw	ton	2-6
Pumping water		
(a) (centrifugal pump)	1,000 gal. ft.	0.005-0.01
(b) (small reciprocating pump)	1,000 gal. ft.	0.01-0.02



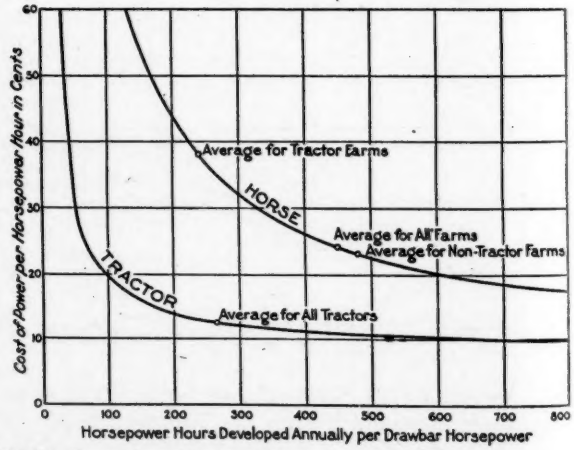


Plate XIV. (Left) Average horsepower-hour cost. Plate XV. (Right) Comparison of cost of horses and tractor power

TABLE IV. APPROXIMATE AVERAGE MAN-HOURS OF LABOR PER ACRE REQUIRED FOR CROP PRODUCTION IN VARIOUS PARTS OF THE UNITED STATES

Area	Corn for grain 1/	Corn for silage	Small grain cut with Binder 2/	Small grain cut with binder com- bine 2/	Hay cut and cured	Potatoes	Tobacco	Cotton 4/	Rice	Sugar beets	Truck crops	Fruit	Cow peas and soy beans 2/
New Eng.	100	100	42		10	100							
N. Y.	66	58	24		10	100		L				170	42
N. J.	69				10	100					150		
Pa.	50	49	24		12	106							
Va.	50		23			82							
W. Va.	57	57	23		8		378						
Ky.	46	60	12				363						18
So. Car.					11	116		136					
Ga.	40		15		20	115	400	125					19
La.	37	48			12	137		100	37				
Ark.	38	48	16		16	94		112	46			140	
Texas					16	47		64	37				
Mo.	24	30	15										25
Ohio	48	51	20		10	120	300			113	150		
Mich.	30	32	19			80				110			40
Wis.	30	30	15		14	82						140	32
Minn.	26	32	12		12	58				155			
Ind.	26	30	15		12								
Ill.	20	28	15		8.4								
Iowa	18	28			7.5	69							
Kansas	16	26	8.5	5	4								
E. Neb.	16	26	10		6								
W.Neb.	12	23	7	5	5								
Dakotas	15	23	7		8	32							
Colo.Dry			7	5	5								
Colo.Irr.			25		12	75				124		362	41
Utah Irr.					13	114				129			
N.W.Irr.			24		15					119		400	30
N.W.Dry			17	7									

1/ Does not include shelling or marketing.
2/ Does not include marketing.
3/ Does not include baling or marketing.
4/ Does not include ginning.

TABLE V. APPROXIMATE AVERAGE HORSE-POWER-HOURS PER ACRE REQUIRED FOR CROP PRODUCTION IN VARIOUS PARTS OF THE UNITED STATES

Area	Corn for grain 1/	Corn for silage	Small grain cut with binder 2/	Small grain cut with Combine 3/	Hay cut and cured	Potatoes	Tobacco	Cotton 4/	Rice	Sugar beets	Truck crops	Fruit	Cow peas and soy beans 2/
New Eng.	55	50	21		5	50							
N. Y.	27	42	23		5	50						45	51
N. J.	27	42			6	50							
Pa.	27	42	22			54							
Va.	30	45				35							
W.Va.	30	45	20		4	42	27						
Ky.	30	45	15		4		44						15
S. C.						33							
Ga.	22		16		12	30	45	30					15
La.	26	41	23		10	42		20	38				
Ark.	26	41	23		9	32		26	42		40	45	
Texas						27		20	40				
Mo.	24	39	18										20
Ohio	30	45	20		6	50	50			40			25
Mich.	30	45	20			40				45	40		25
Wis.	27	42	20		6	40							22
Minn.	27	42	20		8	38				55			
Ind.	30	45	20										
Ill.	26	41	22		6								
Iowa	26	41			6	43							
Kansas	22	38	15	9	4								
E.Neb.	22	38	16		5								
W.Neb.	19	32	14	9	4								
Dakotas	19		15		6	38							
Colo.Dry			15	9	4								
Colo.Irr.			25		7	50				55		62	20
Utah Irr.					6	58				70			
N.W. Irr.			25		7	50				52		70	
N.W. Dry			14	9	4								

1/ Does not include shelling or marketing.
2/ Does not include marketing.
3/ Does not include baling or marketing.
4/ Does not include ginning.

tural worker is less he puts in longer hours and has a higher investment per primary horsepower than any other industry.

In Plate VII is shown an estimate of the total primary horsepower that has been available on farms in the United States since 1850.

The amount of primary horsepower per worker has increased from about 1.5 in 1850 to 4.6 at the present time.

Table I shows the estimated total number of each kind of power units or installations, the total primary horsepower available and the horsepower-hours developed annually by each kind of power. (The total amount of power used annually amounts to almost 16 billions horsepower-hours). In addition to this amount of power used on farms there is expended annually about 30 billion hours of human energy which is distributed approximately as follows: 45 per cent on field work; 35 per cent on live-stock operation; 15 per cent on hauling, and 10 per cent on the care of equipment. This does not include the work done by women in the house.

Plate VIII shows how this power is utilized by the various major farm operations.

Approximately half of the power used on farms is for field work, plowing being the largest item in this group. Hauling represents about 22 per cent of the total power, heavy stationary work 17 per cent, and light stationary work 11 per cent. In the case of hauling, the total amount of power given includes the moving of the tare weight as well as the net load and the return of the empty wagon or truck when no return load is hauled. Pumping and threshing are the only two items for stationary work shown separately on the graph. The other items are so small individually that they have been left off. Some of the larger of these are as follows: Cutting silage requires approximately 50 million horsepower-hours; shelling corn about 80 million; shredding corn 100 million; baling hay 100 million; grinding feed 200 million; operating isolated electric plants 150 million; sawing wood and lumber 100 million. The remainder of the stationary power is used for small operations around the farmstead such as operating line shafts, churns, cream separators, milking machines, washing machines, spray pumps, tool grinders, cleaning and grading grain, hay hoists, elevating grain, and other miscellaneous jobs. In the figures given for pumping about one-third is for domestic purposes and the other two-thirds for irrigation and drainage. The figures given are approximate averages for all conditions in individual cases the power required may vary as much as a hundred per cent, due to the condition of the material being operated on and the condition and efficiency of the machine in use.

Tables IV and V show the total average amount of labor required for producing the principal commodities in a number of the states. Here again the figures given are only averages and the power for any individual case may vary considerably due to tillage and harvest methods, type of soil, climatic conditions, etc.

Perhaps the most interesting and also the most important part of the analysis of the material gathered is that showing the primary power and horsepower-hours utilized annually per worker and per farm by states. This data is shown graphically in Plates IX to XII. The variations in the amount of power per worker are due almost entirely to the size of the machine units in use in the different states, while the amounts of power utilized per farm is largely due to the type of farming followed, the size of farms, the machinery used per worker, the type of soil, and the climatic conditions.

Plate XIII shows the horsepower-hours utilized annually per improved acre. It is probably the best unit to use when estimating the power requirements of different sized farms.

The cost of power is the most important part of a power problem and is at the same time one of the hardest on which to give reliable figures. This is due to the great variety of conditions to be met. Some of the factors affecting the cost of power may be stated as follows: First cost of the primary unit; rate of depreciation; amount of power produced annually by the unit; repairs and labor required for upkeep; mechanical efficiency of the power unit; cost of fuel or feed, etc, In Plate XIV is shown the average cost per horsepower-hour for several kinds of power under 1924 values and is based on developing the number of horsepower-hours per primary horsepower shown in Table I. If the fuel or feed costs more or the unit develops less power annually, the cost will be greater, while if in either case the reverse is true, the cost will be less.

One of the most serious problems encountered in the substitution of horses with tractor power is the fact that

(Continued on page 173)

Research Methods in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the Research Committee. Articles dealing purely with the manipulation of research methods and equipment are featured. Members are invited to discuss material presented and offer suggestions on timely topics

Some Research Features of the Application of Electricity to Agriculture*

By R. W. Trullinger

Mem. A. S. A. E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

THE purpose of this paper is to bring to light and analyze in a preliminary manner some of the apparently more important research features involved in a proposed development, having for its ultimate objective the exclusive use of electricity in all agricultural processes requiring a tangible source of energy.

Data are available from various sources to show that the cost of actual production of electrical energy is in many cases a relatively small item as compared with the cost of transmission, distribution, and transformation. It is easy to understand therefore that with the long-distance transmission required and the relatively small number of consumers per mile of transmission, American agriculture cannot hope generally to secure central station electric service at urban rates as long as there is a no greater rural consumption of electrical energy than that incident to lighting and the miscellaneous small belt and shaft jobs in the house and around the farmyard.

Obviously American agriculture cannot successfully utilize electrical energy unless the cost thereof and the returns from the processes employing it are such as to make the practice a profitable one. Just as obviously the central stations cannot be expected to invest money in equipment for meeting a rural load unless that load is large and constant enough to pay a reasonable return on the investment.

It therefore logically follows that the only way to lower the cost of central station energy to a rate at which its general use in agriculture is profitable, is to increase its profitable agricultural uses to such an extent that the resulting load corresponds to a reasonable rate of profit for both the central stations and the individual farmers.

With this in view and at the request of the Committee on the Relation of Electricity to Agriculture, the Office of Experiment Stations of the U. S. Department of Agriculture undertook an impartial study of the research features of the subject with a view to formulating an investigational and research program to serve as a guide to state institutions and others in the planning and conduct of developmental research on profitable uses of electricity in agricultural processes. This paper constitutes a preliminary progress report of this study to date.

Scope of the Study

It would seem best for present purposes to assume that electrical energy of the proper voltage is available to farmers. This eliminates the purely electrical engineering phases of production, transmission, and transformation for the time being, the problems of which are obvious logical responsibilities of the electrical people themselves. Of course, the nature of such transmission and transformation should be governed largely by the general requirements of farming, and the definite formulation of such requirements for the information and guidance of the central stations is one of the important ultimate considerations. However, before these broad general requirements can be formulated with any degree of finality for different types of agriculture, it would seem necessary first to confine consideration of the problem to its agricultural and agricultural engineering phases to determine the nature of the requirements of the individual processes involved.

Consultation with agricultural engineers throughout the United States and with specialists in other branches of agriculture revealed the strong probability that the problem of the application of electricity to agriculture will touch practically every recognized branch of agricultural investigation. Its progressive development would seem to fall into four major divisions which in their logical order are:

1. The application of electricity as a source of energy to present farming practices.
2. The development of new practices made possible by the use of electricity, including the more complete processing of products.
3. The development of unused natural resources on the farm.
4. The staggering of industrial operations with farm operations to secure constancy as well as size of profitable load.

This paper is limited to present farm practices, since it appears most logical to meet present requirements first and to study the requirements of new practices as the need for their development becomes evident.

The work so far has suggested in a broad general way the possibility of employing electricity as a source of energy in the following very general agricultural practices at present in vogue in different types of agriculture:

1. House lighting.
2. House heating.
3. Cooking.
4. Food preparation, including meat curing.
5. All mechanical operations requiring power, including belt and shaft work, and field operations.
6. Field and truck crop production.
7. Animal production, including feed curing and water heating.
8. Dairying, including milk sterilization and pasteurization.
9. Poultry hubandry and egg production.
10. Orchard practices, including heating.
11. Combating insect pests and hail.
12. Drainage and irrigation pumping.
13. Miscellaneous practices.

House Lighting

Everything indicates that electric lighting, whether of farm or city dwellings and premises, is a well-established and more or less economical practice presenting advantages as to convenience, economy of time, cleanliness, and safety from fire hazards of such a degree as to leave little room for argument against it. From the standpoint of research or investigation, no problem exists for all practic-

*Eighteenth annual meeting paper.

al purposes except the purely electrical one of possible improvement in illuminating detail.

The problem presented by electric lighting on the farm seems to be one purely of economics. The lighting load is fairly constant the year round, but there is ample evidence to indicate that it is not by any means sufficient to justify general rural electrification. European experience (1)** indicates that the lighting load in buildings is usually proportional to the size of the farm. Experience in the province of Ontario, Canada, (2) indicates that the distribution of electrical energy in rural districts must meet at least eight main classes of service, in each of which lighting is included as a necessary incidental to build up the total load but always dependent upon other service to justify it. Experience in an Indiana county (3) in which a rural electric system supplied electric light and power to one hundred strictly farm customers from a central station showed the dependence of the electric light upon other loads to make it economically feasible. Experience in a more or less thickly settled rural community of Vermont (4) showed that electric lighting cost 15 cents per kilowatt-hour up to an energy consumption of 20 kilowatt-hours per month before a reduction in rate was economically feasible. On the other hand, data from twenty-one electrical substations in Denmark (5) showed that, with proper proportions of lighting and motor service loads and correspondingly proportioned rates, cooperative central stations could be made profitable.

House Heating

The heating of houses by electricity is not by any means a well-established practice even in cities, the objection being that it is generally too expensive. However, it also offers a means of increasing the electrical load, and the available information indicates that it is a convenient, effective, clean, and relatively safe means of heating. The fact that it is an expensive method of heating houses as compared with other methods would suggest lack of perfection of detail of the heating apparatus itself as well as inadequate knowledge as to proper manipulation and use. That it is a generally impractical method of heating at present is indicated by the results of experience by the U. S. Reclamation Service (6) on its Minidoka irrigation project. It was found that when using power supplied by the project generating station, electricity at $2 per month per kilowatt will compete with coal at $8 per ton with an average season for heating of from 5 to 6 months. The general conclusion was drawn, however, that while electric heating is sometimes justified as a by-product load, it will rarely if ever be economically feasible to develop electricity from water power for the prime purpose of using it generally to heat buildings, where fuel can be obtained at reasonable prices.

In spite of the unfavorable evidence regarding the use of electricity for heating, this practice obviously offers a problem worthy of consideration. The heating load will undoubtedly add considerably to the total farm load, thus tending to lower the rate for current. The fuel problem is getting to be a serious one and the time may come when electric heating for at least part of the year will of necessity receive serious consideration in some localities. Presumably the problem is one largely of the perfection of heating element and of general manipulation and offers an opportunity for interesting electrical equipment research, as well as agricultural engineering research.

Cooking

Past experience has shown that cooking with electricity is in general not a very economical procedure. However, electric cooking offers another opportunity for farm consumers of electricity to increase the total electrical load. While the fuel situation may be good in some instances as far as cooking is concerned, it is certainly becoming a pressing problem in many localities. The development of the economic use of electricity for this purpose therefore seems worthy of consideration.

The problem in electrical cooking seems to be twofold, the first being one for the attention of the food and cooking specialist and the second being one of the perfection of detail of the cooking apparatus itself, for the attention of the engineer. Obviously the work of the food specialist must come first in order that the exact requirements for the optimum cooking of different foods may be determined to serve as a basis for the perfection of the cooking apparatus and its proper manipulation.

An analysis of the electric cooking load of a central station in southern California (7) supplying over three thousand electric ranges of which 95 per cent are in private houses showed that electric cooking service tends in the long run to conserve both food and fuel. On the other hand, studies of electric ranges at the Kansas State Agricultural College (8) showed that electricity even at 3 cents per kilowatt-hour is an expensive form of fuel for cooking as compared with artificial gas at $1 per 1,000 cubic feet or coal at $8 per ton, costing approximately 100 per cent more than by use of either of these fuels. Thus it is evident that locality and environment are factors for consideration in the development of a profitable electrical cooking load. Undoubtedly where artifical or natural gas is cheap and easily available, it is much more difficult to make a favorable case for electrical cooking than where the same condition exists for electrical energy.

The problem is perhaps more typical and unbiased in localities where neither electricity nor fuels have any initial advantage. For instance, tests were conducted at the University of Missouri (9) with three commercial and several specially constructed experimental electric ovens to determine the amounts of energy consumed in cooking and the best methods of preparing different foods for the electric oven. The results showed that when baking bread, biscuits, etc., the energy lost when the door of an electric even was open for 15 seconds at an oven temperature of 392° F. amounted to 12 watt-hours. The most economical temperature for preparing rare and medium rare roasts was found to be 100° F. and for well-done roasts 120° F. The best range of oven temperatures for baking biscuits was found to be from 200 to 240° F. When starting with the oven at the required temperature, the energy necessary for baking biscuits was found to be practically the same for all oven temperatures. If it was necessary to heat up the oven from the room temperature, the most economical oven temperature was found to be the lowest which will give satisfactory results, that is about 200° F. The best range of temperatures for baking a small sized loaf of bread was found to be from 180 to 240° F. When starting with the oven at the required temperature the most economical temperature for baking bread was between 220 and 240° F. When preheating was included the most economical temperature for a small sized loaf of bread was between 200 and 215° F. The best range of temperature for sponge cake was between 170 and 190° F. As a general proposition, it was found that a heating element in the upper part of the oven is necessary to get the best results for baking at the higher temperatures. It was further found that, on the basis of electricity at 5 cents per kilowatt-hour and allowing an interest and depreciation charge of 25 per cent, the most economical thickness of kieselguhr insulation for domestic use is from 3 to 4 inches.

English experiments (10) on electric cooking showed that the loss in weight of different kinds of meats was apparently less with electric cooking than with gas or coal-fired cooking and the flavor of the product was vastly superior, both being due apparently to the more flexible and precise control of the electric heat. Studies in Australia (11) on the development of economical electric cooking apparatus, including ovens and hot plates, showed that nichrome is the most satisfactory material for the wires and green Australian mica is the best material for the insulator and support for heating units. Slag wool and flaked mica were found to be the best thermal insulators for oven construction.

It is thus plainly evident that the building up of an economical and profitable electric cooking load is not a matter merely of installing some kind of commercial elec-

**The figures in parenthesis indicate references that follow this paper.

trical stove on every farm and doing all cooking therewith. Comparative tests of gas and electricity for cooking (12) under identical conditions with an arbitrarily selected commercial electric stove showed, for example, that the electricity was about four and one-half times as costly as gas for cooking various meats, and about six times as costly for heating water. Similar tests in England (13) gave almost identical results. Obviously then, the development of a profitable electric cooking load must begin with something more fundamental than mere installation of the system or even with comparative tests of different commercial types of electrical cooking apparatus. The food specialist must determine the ranges of temperatures and other conditions for the best and most economical cooking of different foods. With this information as a basis, the engineer must develop electrical cooking apparatus which, with proper manipulation, will satisfactorily meet the cooking requirements with a minimum loss of heat and the most economical utilization of electrical energy.

Food Preparation and Meat Curing

Some phases of food preparation are closely allied to cooking as far as the building up of a rural electrical load is concerned. Such practices as the canning of fruits and vegetables, for example, and the making of preserves and jellies, all of which involve the use of a cooking heat, might be included in the building up of an electric cooking load. As in the cooking of foods, it is necessary to determine the exact requirements for heat and energy in the preparation of such canned foods as a basis for the economical development and operation of the electrical apparatus required. Much work has already been done by home economists and nutrition experts of state and other institutions on the preparation of such foods as canned fruits and vegetables, preserves and jellies, and even canned meats, and considerable data should be available regarding the temperature amounts and ranges required in such processes.

The dehydration of fruits, particularly in the large fruit-producing sections, apparently offers another opportunity for the building up of a profitable electrical load, especially in view of the susceptibility of electrical energy to precise manipulation and control. The work at the California agricultural experiment station (14) brings out in particular some of the important requirements of proper fruit dehydration. The work of the A. S. A. E. Committee on the Manufacture of Farm Products headed by Prof. L. J. Fletcher (15) brought out the importance of securing more fundamental information regarding the best conditions of temperature, moisture, ventilation, etc. to maintain for the dehydration of various fruits, the factors governing which are numerous, extremely variable, and difficult of exact measurement and control. The problem is clear cut as far as the building up of a profitable electrical load is concerned.

The use of an electric current in meat curing has been found to offer possibilities as a process and incidentally as a means for building up a rural electric load. Experiments are on record (16) which indicate that the passage of an electric current through a vat containing meat in pickle is an effective curing process. Further experiments (17) showed that meat cures more rapidly than by the usual process when it is placed in pickle in vats containing systems of electrodes at each end, forming poles from which an electric current passes through the brine and meat, alternating from pole to pole. Other experiments on this process (18) indicated that the sodium chlorid in the brine is dissociated by the electric current and recombined in the meat, forming sodium hypochlorite, thus bringing the meat into contact with a solution of a strong antiseptic. Evidently much investigational work is necessary before this process is perfected or even its feasibility established.

Mechanical Farm Operations

The use of electricity as the source of energy in the large number of belt, shaft, direct drive and traction jobs around the farmhouse and yard and in the field offers perhaps the biggest opportunity for the building up of a substantial and economical rural electrical load. These jobs are so numerous as to make it impracticable to discuss them all in this paper. The power requirements of many of them are so well known and so nearly the same as to offer practically no problem from the standpoint of research or investigation. The work of Duffee and Palmer at the University of Wisconsin brought much data of this nature to light (19). Other studies reported to the American Society of Agricultural Engineers (20) on small motor applications for farm work showed, for instance, that 1 cent's worth of electricity at 10 cents per kilowatt-hour will operate a 6-pound flat iron for 15 minutes, drive an electric vacuum cleaner long enough to clean 450 square feet of carpet, lift 100 gallons of water 100 feet, keep a heating pad hot for from two to three hours, or run a sewing machine for two hours, a 12-inch electric fan for two hours, or a buffer and grinder for 1¾ hours. These and other small motor uses apparently offer little opportunity for further development along economical lines except perhaps improvement in minor mechanical detail.

While these mechanical operations using small motors would seem to offer no particular problem, when the larger belt, shaft, and traction operations are taken into consideration, the problem is such as to be no longer susceptible of solution by belting a standard motor to existing power machinery. This point has been brought out forcibly in studies of the use of electrical energy in agriculture on the European continent (1). The limited seasonal use of much of the machinery and the extremely variable power requirements of machinery for different operations, and in some cases for the same operation, are most important factors adding to the complexity of the problem. The work at the Wisconsin station on silage cutters, in which power requirements, capacities, and best operating speeds varied widely, serves as a striking example of the problem confronting those who propose to use electrical energy generally for this class of work.

Perhaps one of the largest possible uses of electrical energy in mechanical operations would be in field work such as plowing, cultivating, etc. The load on such work would extend practically throughout the growing season and might be extended further if electric tractors and trucks were developed suitable for farm hauling conditions. In this connection the problem of direct electric drive for traction operations on the farm seems to lie in the development of tractors employing electric motors which are fed either indirectly by cable from a transmission line or directly by a storage battery. The problems in either case have apparently never been solved with any marked degree of satisfaction.

Some work has been done both in this country and abroad on the development of electric tractors fed by cable. Some such work was done at the California station some years ago (21), and it is understood that work along similar lines is still in progress at that station. The original experiments demonstrated, by what was considered to be a crude experimental machine, that the soil could actually be cultivated by electric power and that there were at least no fundamental obstacles. A light machine was found to be desirable for garden work owing to the ease of handling and the reduced power consumption. The overload capacity of an electric motor was found to be an important feature in its favor for such work. No information is available as to the present status of this work. The Alabama station is also planning to undertake development work along this line.

Studies conducted in Sweden (22) have resulted in the development of a system of cultivation by means of which an electric tractor with an attached plow and overhead electric cable winding on a drum is used. The field is divided so as to reduce the distance through which the plow has to be driven along the headlands to a minimum, and an open furrow is left midway between two ridges. During a short test a rubber insulated cable showed no signs of wear, while during a longtime test a cable under stress was drawn over pulleys at the mast and over a part of the cable drum for a distance of about 4,600 miles with-

out being ruined. Much is apparently yet to be learned before this type of tractor can be made a success.

Experiments in France (23) with various systems of power plowing using electricity as a source of power indicated that tractors are not essential for deep plowing. The windlass and cable method using a stationary source of power indicated that tractors are not essential for deep plowing. The windlass and cable method using a stationary source of power at the end of the field are found to be equally effective and to use cheaper and more durable equipment. However, while the minimum horsepower theoretically necessary was about thirty, the actual minimum necessary horsepower of an outfit was about sixty, in order to provide a sufficient factor of safety for roots, stones, and other losses. In fact, electric windlasses built for plowing service generally are capable of from 75 to 100 horsepower, such machines being able to plow from 8.5 acres to about 15 acres per day of 12 hours. When considering power required and accomplishment, such outfits in their present stage of development do not compare very favorably with our light and rather flexible internal-combustion tractors developing relatively much less power. Further experiments in Germany (24) with similar outfits showed that while plowing in this manner with a gang plow may be a profitable operation, it can not be so unless fitted into the general scheme of profitable utilization of electricity throughout the year. Data from other farm experience in Europe (25) showed that the first cost of a practical electric plowing system of this type averages about $10,000. On the other hand, Italian experiments (26) have shown that electrical power for plowing when available at from 3 to 5 cents per kilowatt-hour is considerably cheaper than steam or animal power.

It is thus plainly evident that the development of an effective and economical tractor or plowing outfit has never proceeded much beyond the preliminary stages. The variable results so far obtained would indicate that not enough is yet known about plowing and cultivating and the machinery suitable therefor to form a sound basis for the final development of electrical traction plowing apparatus. Everything indicates that such development must follow the elucidation and establishment of the fundamental principles of soil dynamics and the development of corresponding tillage machinery if it is to provide a profitable addition to the farm electrical load. There are so many unknown factors of soil dynamics affecting tillage and other factors such as speed of operation, friction, impulsive traction, etc., all of which will influence the development of electrical power units for cultivation as to make it seem quite impractical at this time to undertake the manufacture of electrical tractors for tillage operations except for experimental use.

In this connection, attention may well be drawn to recent studies conducted at the Rothamsted experimental station in England (27) on an electrical method for the reduction of draft in plowing. On the basis that an appreciable fraction, estimated roughly at one-third, of the total work done in plowing is expended in overcoming the frictional forces between the moldboard and the soil, an electrical method of reducing the friction on moist surfaces which depends upon the phenomenon of electroendosmose exhibited by moist soil was developed. It was found that, by virtue of the negative charge of the soil colloids, water will move through moist soil toward the negative electrode under the action of an electric current. It was found both in the laboratory and in the field that, if a current was passed through the soil having the moldboard of a plow as the negative electrode, the film of water formed at the soil-metal surface acted as a lubricant and reduced the plowing draft. Especially striking reductions in frictional losses were obtained by the use of such current in laboratory experiments in which a slider consisting of a weighted metal spatula was drawn over the surface of a slab of moist soil in a metal tray by means of a thread passing over a pulley to a scale pan. Preliminary tests in the field demonstrated that the draft of a plow could be reduced by applying the current between the coulter and the moldboard. While the magnitude of the reduction obtained with this arrangement was not great enough to have an immediate practical value, the method is considered to offer marked possibilities for further development along practical and profitable lines. Thus if practical electrical plowing apparatus were available, these experiments would suggest the possibility of developing a twofold profitable use of electricity in plowing operations.

Much the same general indecision prevails throughout results of experience on the use of electricity in the other larger power operations of the farm. Experiments in Ontario, Canada, (28) have shown that motors developing from 1 to 8 horsepower will do all of the ordinary power work on the farm, while for the heavier work such as threshing, silo filling, feed grinding, etc., at least 20 horsepower motors are required. Experiments already reported to the American Society of Agricultural Engineers (20) demonstrated the variable power requirements of different operations and machines. At the same time it was shown that a feed grinder could be operated at 650 revolutions per minute by a 5-horsepower motor when grinding corn with a power consumption of 0.433 kilowatt-hours per bushel and by a 15-horsepower motor under similar conditions with a power consumption of 0.411 kilowatt-hours per bushel. Another significant finding was that a small thresher having a 28-inch cylinder and a 42-inch separator could be driven by a 15 horsepower motor with power consumptions of 2.62, 2.36, and 2.7 kilowatt-hours per ton of oats, barley, and wheat, respectively. The results of threshing experiments in Iowa (29), in which an outfit consisting of a 30-horsepower, 220-volt, 60-cycle, single-phase motor was used with a threshing machine having a 32-inch cylinder and a 54-inch separator on barley separation, showed that with electricity at 5 cents per kilowatt-hour the operating expense was 25 per cent less than that by steam engine. About 6.5 bushels of barley were threshed per kilowatt-hour of power used.

On the other hand, experiments in Germany (30) showed that steam engine power was essentially cheaper and more efficient than electrical energy for threshing. Other German experiments (31) gave similar results generally in favor of steam power. However, French tests (32) demonstrated the superiority of electrical energy over horsepower for threshing in both cost and accomplishment. German experiments (33) confirmed these results, indicating that the work accomplished by electric motors in threshing was nearly 17 per cent greater than that by horsepower owing largely to uniformity of operation.

Experiments in a rural community (34) on the comparative values of steam power and electrical energy for silo filling showed that the daily rent, including the cost of the energy consumed by a 15-horsepower electric motor with transformer mounted on a truck, was considerably less than the expense of using a steam traction engine. The average required per ton of silage cut and elevated was 1.17 kilowatt-hours. Some question may be raised as to the general applicability of these results when the variable power requirements, speeds, and capacities of different silo fillers are considered, especially as indicated by the Wisconsin experiments. It would seem that before electricity can be applied most effectively and economically to silage cutting and elevating, more must be learned about the power and speed requirements of these processes as a basis for the development of the machinery involved along more rational and standardized lines.

There are many other mechanical farm operations of medium power requirement which have been successfully performed with electric motors such as ice harvesting (35, 36), operating refrigerating apparatus, binder driving, etc. Records of such experience also exist, indicating that electric power does not compare favorably with other forms of power. For example, experiments conducted in Germany (37) on the efficiency and economy of steam and internal-combustion engines and electric motors for a large number of medium power mechanical farm operations showed that the internal-combustion engine was the most efficient type of power for the smaller operations under actual working conditions. The steam engine usually

gave better results for the heavier operations. The results in general were more or less unfavorable to the use of central station electricity on farms for this purpose. In the face of these results, experiments conducted at the University of Missouri (38) led to the conclusion that the convenience and ease of operation of electric motors are such as to make their daily use profitable in many farm operations.

A careful consideration of this brief summary of significant but nevertheless more or less conflicting results would seem to indicate that the use of electric motors generally in practically all mechanical farm operations is a quite promising possibility, which incidentally also offers a quite considerable field for the building up of the total electrical load. However, the general conclusion drawn from extensive European experiments (39) that any farm machine which revolves or has revolving parts can be operated by electric motor more effectively and economically than by any other means is undoubtedly extremely optimistic with reference to the present status of the use of electricity in agriculture. On the other hand, when it is considered that this conclusion is based upon a proposed fundamental study of the requirements of each process and machine as a basis for the gradual and rational application of electrical power, it would seem to sound somewhat more reasonable.

Owing to the attendant power losses, it would seem that success in this undertaking lies largely in the development of the use of smaller power units in agricultural operations. This is borne out by experimental data already available and strongly indicates the ultimate necessity of overhauling practically all of the larger power operations with a view to effecting the application of smaller units operating over longer periods of time. This will involve a complete study of the fundamental requirements of all mechanical operations to determine how far such a procedure can be extended and may mean the complete redevelopment of a number of agricultural machines. The necessity for such a study of process requirements and the development of corresponding machines is indicated anyhow in the case of many machines such as silage cutters, tillage machinery, and others which show a broad variation in operating characteristics among the commercially available types. It seems evident therefore that the building up of a profitable electrical load in connection with mechanical farm operations must inevitably be the result of very intensive research and investigation leading to the very gradual development of individual processes and machines.

Crop Production

The use of electricity in crop production, entirely aside from the mechanical operations involved, has held the attention of scientists in this and other countries for several decades. In fact, there is available a history of research involved in the gradual development of so-called electroculture extending back over a period of at least 40 years.

An effort has undoubtedly been made in this work to get at the fundamentals of the process. The investigators have obviously been less interetsted in the building up of an electrical load than they have in establishing the nature of the stimulation of crop growth and yield by electricity and in making a profitable application of the process.

The work of electroculture so far is, however, obviously quite incomplete and has been productive of more or less unsatisfactory and in many cases contradictory results. On the other hand, as it has progressed through a very gradual but nevertheless altogether normal development, it has indicated certain very definite lines of fundamental study, each of which may have a more or less marked influence on the success or failure of the process.

These lines of study may be grouped broadly under stimulation by electric light, by overhead atmospheric electrical discharge, by soil electrification, and by electrical seed treatment either direct or indirect. While no attempt will be made to give the complete history of each line of work, attention wil be drawn to a sufficient number of typical instances to indicate general results and tendencies.

Effect of electric light on crop growth. A long series of studies were conducted at the New York Cornell station (40) on the influence of the electric arc light upon greenhouse plants. These showed as a whole that the electric arc light promoted assimilation, hastened growth and maturity, was capable of producing natural flavors and colors in fruits, and increased the production of flowers. Periods of darkness were found to be unnecessary to the growth and development of plants. A continuation of this work (41) in which an arc light with a clear glass globe was hung above the greenhouse showed that lettuce was greatly benefited, radishes, beets, and spinach were somewhat benefited, cauliflowers tended to grow taller and make fewer and smaller heads, while with endives the results were negative. The electric light did not appear to determine or modify the periods of growth of lettuce. Further studies (42) showed that a naked electric arc lamp in the greenhouse greatly injured cauliflowers growing near it, but exerted little influence beyond 10 feet. Electric light transmitted through glass screens of different colors exerted decided influences on radish and lettuce plants early in their growth, which tended to disappear as the plants approached maturity. Tests of the effect of incandescent electric light plants in greenhouses at the West Virginia station (43) showed that the incandescent light had a marked effect upon greenhouse plants, especially in foliage growth for plants such as lettuce. It induced objectionable early running to seed in such plants as spinach and endive. Proper watering appeared to be more important for radishes, beans, and cuttings than improper watering with electric light. The results were more marked the stronger the light. There was some doubt as to the economy of this process.

Austrian experiments (44) on the influence of varying the intensity and duration of illumination on such crops as beans, mustard, and wheat showed that continuous illumination with carbon lamps of from 25 to 100 candlepower followed by darkness persistently retarded growth, while lower candlepower lights accelerated growth. German experiments (45) showed that seeds germinate earlier under electric light and that bulbs, beets, beans, flax, and other plants produce seed earlier. Other experiments in this country (46) indicated the superiority of ruby light for radishes and violet light for lettuce, especially under high frequency.

These experiments as a whole indicate that artifical illumination of crops by electricity offers considerable possibility. Apparently the advantage gained lies mainly in hastened maturity which is of course a disadvantage in the case of some truck crops. Incandescent lights seem to be somewhat superior to arc lights and apparently the color spectrum has a bearing on the matter. It would seem that the problem now is to determine those plants actually benefited by such treatment, the nature of the benefit, their specific requirements for light to produce optimum growth and yield, and the degree and color of illumination giving the most profitable results as a basis for developing this practice as a part of the rural electrical program.

Effect of atmospheric electric stimulation on crop growth. The results of experience in the overhead electrical treatment of crops have been many and varied. Early experiments at the Massachusetts station (47) gave results generally in favor of overhead electrification of crops. French studies (48) showed that electrical currents have a direct and indirect influence upuon plants. Under the direct influence the protoplasmic memrbane loses its semipermeable nature and permits the electrolytes to escape from the cells. The albuminoid systems of the cells behave themselves in a similar manner, their ions escaping from the cell and distributing themselves toward the positive or negative electrodes in proportion to their electrolytic nature.

Experiments in this country with vegetables (46) showed that plants subjected to high frequency electrification produced greater increases than under any other type of treatment. On a large scale such treatment increased the yield of all garden crops except beans and peas. Similar results were obtained in English experiments (49), it be-

ing found that with a few exceptions leguminous crops were adversely affected.

Pot culture experiments conducted in Germany (50), in which a current of from 35,000 to 40,000 volts was taken from a machine and made to jump a distance of 15 centimeters from a copper wire point suspended over each pot to an upright copper wire point in the center of the pot, showed that when the suspended point was connected with either the positive or negative pole the current had an injurious effect upon rye and winter barley when applied during a period of from 16 to 20 days at stated intervals. Reducing the charge increased these crops, especially when the copper points in the pots were removed. In open-air experiments the atmospheric moisture interfered with uniform discharges and resulted in yields varying from 5 per cent increase to 17 per cent decrease. When the discharge took place from points placed 13 centimeters above a water surface, the exaporation was from five to ten times more rapid that from an untreated surface.

Bohemian experiments (51), in which insulated wire nets stretched at a height of from 12 to 15 feet above growing beets were subjected to an electric current of from 50,000 to 70,000 volts and from 0.7 to 0.8 milliamperes, resulted in noticeably increased crop production and difference in chemical composition of the product, which were attributed to a direct influence of the electricity upon the soil rather than upon the plant. German experiments (52) with an electrical brush discharge of high tension showed no decided beneficial effects upon the growth of several cereals. Previous beneficial results were attributed largely to an increase of transpiration produced by the electrical wind attending the brush discharge.

Experiments (53) on the application of a voltage stress to the atmosphere around plants caused good results only when the stress was applied on cloudy days and at night. No difference in stimulative effect was found when using the ground as a positive or a negative, and there was some tendency to show for all plants a curve approximating a straight line within certain limits, the slope of which was different for each plant. The general conclusion was drawn from these experiments that indirect stimulation of the root or plant increases the functional activity of the organs if they are far enough from the point of application of the stimulus to avoid the effect of direct stimulation. Although the immediate effect of direct stimulation was to retard growth, it increased the internal energy of the plant and the after effect was to increase the growth rate.

(To be concluded in the September issue)

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Engineering in the Farm Home

By wearing a pedometer, an Iowa farm woman found she usually walked 5 miles each day in preparing meals for her family of three. With the aid of a member of the state agricultural extension service, she studied the placing of her kitchen equipment. After rearranging it to meet her particular needs more effectively, her pedometer showed that the distance she had to walk in preparing on day's meals was but 2½ miles, just half that required before.

Survey of Agricultural Engineering Progress

A review of current literature on engineering as applied to agriculture prepared monthly by Robert W. Trullinger, Mem. A. S. A. E., specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Estimating Building Costs. C. F. Dingman. (New York and London: McGraw-Hill Book Co., Inc., 1923, pp. VIII—240). This is a handbook of information on the estimation of building costs. It contains chapters on excavating, grading and bracing; brick work; stone work, cement-block work, and architectural terra cotta; fireproofing and fireproof construction; plain and reinforced concrete; timber framing; boarding, planking, and shingling; finished carpenter work; tsructural steel and iron work and steel sash; lathing, plastering, and stucco work; painting and paper hanging; roofing and sheet metal, damp proofing, and water proofing; and short-cut methods of estimating.

Erosion and Surface run Off Under Different Soil Conditions, F. L. Duley and M. F. Miller. (Missouri Station Research Bulletin 63 (1923), pp. 5-50, figs. 22). Experiments covering a six-year period are described, in which the amount of run-off and soil eroded were measured after each rain from seven plats having different cropping systems or tillage treatments. The plats, which were each 1/80 acre in area, were elongated in form and ran up and down slope averaging 3.68 feet to 100 feet. Concrete tanks at the lower ends served to collect the run-off and eroded soil from each plat. Each plat was given a different treatment, which included (1) no cultivation with all weeds pulled, (2) 4-inch spading in the spring and cultivation after rains, (3) 8-inch spading in the spring and cultivation after rains, (4) blue grass sod, (5) wheat annually, (6) a rotation of corn, wheat, and clover, and (7) corn annually.

The average run-off varied from 48.92 per cent of the rainfall on the uncultivated plat to 11.55 per cent on the blue grass sod plat. The land spaded 8 inches deep in the spring absorbed only 2.9 per cent more rainfall than that spaded 4 inches. This is taken to indicate that deep plowing of farm lands can be expected to have only a slight advantage over shallow plowing with reference to the absorption of rainfall. Uncropped land, whether cultivated or uncultivated, absorbed much less water than grass or clover land. Land in a rotation of corn, wheat, and clover lost only 14.14 per cent of the rainfall as run-off. The surface inches of rainfall absorbed by uncropped land or by land growing a cultivated crop like corn was practically constant from year to year for a given soil condition, regardless of the wide variation in the annual precipitation. The absorption by sod, wheat, and rotated land was more variable.

The average annual rainfall for the six years of the experiments was 35.87 inches or 1.37 inches below normal. The seasonal distribution of rainfall was also somewhat below normal during the winter and summer and above normal during the spring and fall months. The times of maximum run-off and erosion were during March, April, August, and September. On plats 2, 3, 4, and 6 more than 50 per cent of the erosion took place during August and September. The annual erosion from spaded land where no crop was grown was greater than from soil which was not stirred.

Deep spading reduced the loss from erosion only 13.4 per cent as compared with the shallow spading. This is taken to indicate that deep plowing is less effective in controlling erosion than is usually supposed. In addition, the total loss from the deep spaded land without a crop was very high as compared with cropped land. The presence of a corn crop reduced the erosion of deep spaded land by 50 per cent as compared with the uncropped land, wheat reduced it 81 per cent, and rotation 93 per cent. Sod land lost only 0.68 per cent as much soil as the uncropped soil spaded 4 inches deep.

A direct correlation of the amount of soil eroded with the number of heavy rains occuring during the year showed that the soil eroded during sixteen of the most destructive rains in the six years under consideration was more than 50 per cent of the total erosion of the seven plats.

Chemical analyses showed that the amounts of nitrogen, phosphorus, calcium, and sulphur in the eroded material from corn or wheat land may equal or exceed the amounts taken off in the crops. Only small amounts of nitrogen were lost as nitrates in the run-off water. Mechanical analyses showed that the material eroded from the bare and the cultivated plats contained a higher percentage of sand and a lower percentage of fine material than the soil lost from the other plats.

The results as a whole are taken to indicate that much can be done in the corn belt towards reducing run-off and the disastrous effects of erosion by planning crop rotations in such a way that the land will be covered with a growing crop a very large portion of the time.

A Study of the Relationship Between the Oxygen-Consuming Power of Water and its H-ion Concentration, F. W. Fabian and W. L. Mallmann. (Michigan Station Report 1922, pp 199-202). Studies of samples of water obtained from wells in the vicinity of the station showed that H-ion concentration decreased upon standing and the oxygen-consuming power and bacterial count first increased and then decreased. There seemed to be no relationship between the H-ion concentration and the oxygen-consuming power, although a relationship did seem to exist between the number of bacteria present and the oxygen-consuming power.

A Brief Review of Electric Light in Greenhouse Culture, H. Findlay. (Market Growers Journal, Louisville, Ky. 34 (1924), No. 5, pp. 31-35, 36, figs. 3). Data from different sources on the use of electriclight in greenhouse culture experiments are summarized, and the results of studies conducted at Columbia University, with such vegetables as string beans, peas, sugar corn, cabbage, tomatoes, celery, lettuce, and onions under the influence of 500-watt, 110-volt, nitrogen-filled Mazda clear lamps are reported.

Marked increases of growth were noted in plants treated with artificial lights plus sunlight over plants grown under sunlight alone. It is noted that the average temparature of the plants under the lamps was 22 degrees Fahrenheit higher than that of the plants under sunlight only, and it is thought that this heat had much to do with the rapid growth of the plants.

It is not recommended that vegetable growers invest in such equipment at this time owing to the fact that the work is still in an experimental stage. The opinion is expressed that the economic value of this process to commercial growers depends on the cost of engineering the project and in maintaining the installation at maximum efficiency to bring the evident effect of the artificial light on production.

Researches on the Structural Design of Highways by the U. S. Bureau of Public Roads, A. T. Goldbeck. (American Society of Civil Engineers Proclamation, 50 (1924), No. 4. [pt. 3] pp, 453-489, figs. 26). In a contribution from the U. S. D. A., Bureau of Public Roads, a brief summary is given of those phases of research being conducted which are concerned with the structural features of highway design. These are considered under researches on (1) the subgrade, (2) loads on pavements, (3) stresses in concrete pavements, and (4) materials. Miscellaneous investigations are described, and some of the data from the Pittsburg, Calif., test road are included.

In studies of loads on pavements, it has been found that impact depends largely on the kind and condition of the tire. Thin or worn solid rubber tires, even though they be wide, produce high impact forces. Pneumatic tires offer the greatest aid in reducing impact forces, the impact increasing only slightly with the speed of the truck. Cushion tires offer corresponding advantages in reducing impact. Impact has been found to increase with the speed of the truck, but not according to any constant ratio or power of the speed. Although heavy unsprung weight may give higher impact than lighter unsprung weight, it is not considered to be the major controlling factor. Impact may be as high as seven times the static load on one rear wheel when a solid-tired truck strikes a 1-inch obstruction at sixteen miles per hour, an average value being about four times. For pneumatic tires the maximum impact value is probably not more than 1.75 times the load on one rear wheel and an average value is not more than 1.25 times this load. All cushion wheels do not reduce impact on the road surface even though they may cushion the vehicle.

What the Farmer Wants Is an All-Purpose Tractor, D. C. Heitshu. (Chilton Tractor and Implement Journal, Philadelphia 12 (1924), No. 3, pp. 5-7, figs. 8). In a contribution from the Virginia Polytechnic Institute an analysis is given of the requirements governing the use of tractors on farms, with particular reference to conditions in Virginia. It is pointed out that while the farmer must be able to cultivate with power the ordinary plowing type of tractor does not reduce the labor peaks or the number of work animals required.

Tabular and graphic data are presented which indicate that for Virginia conditions the general utility tractor of medium size should absorb all peak loads, give a better distribution of horse labor, reduce the required number of work stock, and work more days a year.

Air Leakage Through the Openings in Buildings, F. C. Houghten and C. C. Schrader. (Journal American Society of Heating and Ventilating Engineers, New York 30 (1924), No. 2, pp. 121-134, figs. 11). Studies conducted by the U. S. Bureau of Mines in cooperation with the American Institute of Architects and the American Society of Heating and Ventilating Engineers on the leakage of air through and around a double hung window, 2 feet 8 inches by 5 feet 2 inches by 1 3/8 inches, in a 13-inch brick wall plastered on one side with cement plaster, are reported.

In preliminary tests it was found that leakage through the window consists of (1) that which passes through the cracks around the sash perimeter which are subject to weather stripping, (2) that which passes through the cracks between the frame and the brick and can be eliminated by calking under the staff bead or

brick mold and (3) that which passes through other cracks in the frame or sash and which can not be eliminated by either weather stripping or calking.

The wall under a 15-mile wind allowed the passage of 0.111 cubic feet of air per minute, while the leakage through the window and frame for the same wind velocity was 47.5, 9.7, and 7.8 cubic feet per minute for the plain window and two types of weather stripping, respectively. The area of the window and frame was 16.25 square feet, giving a leakage of 2.82, 0.597, and 0.48 cubic feet per minute per square foot of window without and with two types of weather stripping. Based upon these figures, the leakage through the window and frame varied from four to twenty-eight times that through the same area of wall. When the usual greater area of wall over that of window is considered, it is evident that the leakage into a room is usually greater through the wall than through the window is weather stripped, and not many times less if not weather stripped.

A comparison of the heat loss through windows and walls by transmission and leakage showed that under a 15-mile wind there was a heat loss of 2,580,527 and 423 B. t. u. per hour through the window without and with two types of weather stripping, respectively, for a 50 degree temperature difference. The heat loss through the wall was 6.03 B. t. u. per hour. The heat loss as thus indicated by infiltration is 43 per cent as great as the heat loss by transmission.

Electrification of farms in Sweden, T. Holmgren. (Electrical World, New York 83 (1924), No. 4, pp. 178-182, figs. 5). Swedish experiments on the application of electricity to farm processes are outlined in some detail, and the conclusion is drawn that an economically sound electrification of rural districts requires the cooperation of the vast majority of the farmers. A thorough investigation of the proper system of distribution should be made before the details of electrification are decided. The design and size of transformers on the farms, the magnetizing current of motors, and the diversity factor at threshing are considered to be points of great importance in this connection. It is stated that in Sweden the consumption of energy in the first year is commonly confined to lighting and threshing, but the load increases from year to year to about 18 kilowatt-hours per acre. It is usually possible to electrify where the area of cultivated ground amounts to 25 or 30 per cent of the total area.

Flow of Water Through Sluices and Scale Models, H. E. Hurst and D. A. F. Watt. (Engineering and Contracting, Water Works, Chicago 61 (1924). In a paper presented before the Institution of Civil Engineers, London, experiments conducted at the Assuan Dam with six models of a sluice made to scales of 3 to 200, 1 to 50, and 3 to 100 in wood, wood and metal, and metal are reported. The head of water used was to the same scale as the model.

When the experiments were arrangd in groups of six according to head and opening, the maximum departure of the mean of any group from this relation was 5 per cent when the sluice opening was running full and was not acting as a weir. Excluding flow under weir conditions, the mean departure for all models was 0.4 per cent and the mean departure, disregarding sign, was 1.5 per cent. Lower velocities occurred with flow under weir conditions, and, although at the higher heads the above relation held, as the head and velocity decreased a point was reached below which the relation was rapidly departed from. On the models used this point occurred with a head of about 3 centimeters above the sill of the sluice. Below this head the discharge of the models rapidly decreased relatively to that of the actual sluice.

Experiments were conducted after roughening the surface of one model with coatings of sand of two grades of fineness. The mean diameter of the grains were estimated at 0.25 and 0.5 millimeter. On the average the effect of these coatings was to reduce the discharge by 3.5 and 6 per cent, respectively, but the effect varied with the head and the amount of opening of the sluice gate.

It is concluded that models can be used to determine the discharge of large sluices with an average accuracy as good as that obtainable by current measurements.

An improved Method of Determining the Heat Transfer Through Wall, Floor, and Roof Sections, R. F. Morris, H. H. Germond, and C. M. Tuttle. (Juornal American Society of Heating and Ventilating Engineers, New York 30 (1924), No. 2, pp. 109-114, fig. 1). This method is outlined in detail.

Machine Threshing and Seed Grain, M. Ringlemann. (Journal d'Agriculture Pratique, Paris, new series, 41 (1924), No. 6, pp. 111-113). Data from different sources are summarized to show that machine threshing of seed grain has a tendency to so injure it mechanically as to reduce its germinative powers, especially if treated with copper sulphate. Germination tests of hand and machine thresher grain when treated with copper sulphate gave results in favor of the hand threshed grain. Tests of treated and untreated machine threshed grain gave results in favor of the untreated grain. A comparison of grains of wheat, rye, barley, and spelt injured to destruction by hand and machine threshing showed that the loss of the machin threshing was from two to four times as great as that from hand threshing. The injury was greater the larger the seeds. Pointed teeth gave better results than full teeth in the threshing cylinder. It is concluded that for seed grain the threshing, if mechanical, should be performed in two operations, the first being a slow speed operation.

Cultivation of Soil With Explosives, A. Sacchi. (L'Istria Agricola, Parenzo, new series, 2 (1922), No. 24, pp. 577-583). Data on the breaking of six different types of soil by use of the explosive influence of ballistite are briefly summarized. The soils varied from shallow rocky material covered with bushes to deep productive soils of a high state of fertility and cultivation.

The necessary depth of blasing varied from 70 centimeters (27.5 inches) to one meter (3.28 feet). Holes were bored 10 centimeters in diameter and were separated by distances of one meter for rocky soil, 1.25 meters fro gravelly soil, and .4 meters for productive rocky soil, 1.25 meters for gravelly soil, and, 1.4 meters for productive soils free from roots. The charge of ballistite necessary for the proper breaking of the different soils varied from 200 to 300 grams compressed into cartridges.

Design of Concrete Structures, L. C. Urquhart and C. E. O'Rourke. (New York and London: McGraw-Hill Book Company, Inc., 1923, pp IX—452, figs. 190). This book is a textbook on concrete and reinforced concrete, in which the theory of design involved is developed with illustrative problems and complete designs of the essential features of the more common concrete structures are presented. Chapters are included on plain concrete; general properties of reinforced concrete; beams and slabs; bending and direct stress; columns; stresse in continuous beams and building frames; foundations; reinforced concrete buildings; retaining walls; arches; slab, beam, and girder bridges; and forms.

The Flow of Water Through Pipe Culverts, D. L. Yarnell, S. S. Woodward, and F. A. Nagler. (U. S. Deptrtment of Agriculture, Public Roads, 5 (1924), No. 1, pp. 19-33, figs. 15). A series of tests conducted by the U. S. Department of Agriculture, Bureau of Public Roads, in cooperation with the State University of Iowa, on the flow of water through short pipes, such as culverts, are reported. A total of 1,480 tests were made on concrete, vitrified clay, and corrugated metal pipe culverts flowing partly full and full, with both a free and submerged outlet. The sizes tested of each kind were 12, 18, 24, and 30 inches in diameter. The 24-inch pipe of the three kinds of material were tested in lengths of 24, 30, and 36 feet to determine the effect of length on flow. Several types of entrance were used to determine their effects in reducing the entrance loss, including all of the standard types approved by the bureau, which consist of the straight end head wall, wing walls set at 45 degrees to the pipe line, and the U-type wing. The effect of varying the height of wing wall was also tested. A study was also made of the flow through pipe culverts without any head walls. The maximum range of head obtained on the culverts varied from 1.05 feet on the 30-inch clay pipe to 3.29 feet on the 12-inch clay pipe.

The results showed that the discharging capacity of a pipe culvert depends primarily on the cross section of the pipe and the difference in water level at the two ends of the culvert. To obtain the maximum discharge, the pipe must be so laid as to insure that its full cross section is filled by the flowing water. If a culvert pipe is so laid that both its upstream and downstream ends are completely submerged, the amount of water which it discharges will be proportional to the square root of the difference in water level at the two ends, and the exact grade at which the culvert pipe is laid will have no effect whatever on its maximum discharge capacity.

The coefficient of roughness n in the Kutter formula was found to range from 0.012 for the 12-inch size to 0.013 for the 30-inch size of concrete pipe, from 0.01 for the 12-inch size to 0.013 for the 30-inch size of vitrified clay pipe, and from 0.019 for the 12-inch size to 0.023 for the 30-inch size of corrugated meatl pipe.

The effect of the length of the culvert on the discharge was not as great with concrete and vitrified clay pipe as with corrugated metal pipe. The 45 degree wing walls increased the capacityof a corrugated metal pipe culvert from 1 to 10 per cent over that obtained in a metal pipe culvert with a straight end wall, and were more efficient when set flush with the edge of the pipe than when set 6 inches back from the edge of the pipe. They were also more efficient when built full height to the top of the head wall than when constructed standard height. When used in connection with a vitrified clay pipe culvert the 45 degree wing walls were not so effective as the straight end wall entrance with the regular bell end upstream. The U-type wings were also not so effective as the straight end wall for a vitrified clay pipe culvert. The beveled lip end at the entrance of a concrete pipe culvert was found to be of great aid in rdeucing the entrance loss, especially in the larger sizes. The same was true of the bell end at the entrance of vitrified clay pipe, especially iin the smaller sizes. The capacity of a 24-inch vitrified clay pipe culvert could be increased approximately 13 per cent by merely rounding the entrance.

Wall Plaster: Its Ingredients, Preparation, and Properties (U. S. Department of Commerce, Bureau of Standards Circular 151 (1924), pp. 66). This paper reports an attempt to collect and correlate information about the factors which enter into successful plastering.

Power Plant Electrical Equipment. (Chicago: Technical Publishing Company, 1923, pp. 96, figs. 56). This publication contains chapters on general principles of direct-current generators and motors, starting and stopping direct-current generators, armature and field windings, operation of direct-current generators, locating faults and making repairs, principle of alternating current generators, location and care of alternating current generators, alternating current motors, synchronous motors, motor generators and converters, and transformers and their connections.

Boilers, Furnaces, and Boiler Accessories. (Chicago: Technical Publishing Company, 1923, pp. 112, figs. 46). Chapters are contained in this publication on essentials of furnace operation, testing correctness of combustion, sampling and determining quality of fuel, furnaces for coal, mechanical stokers, powdered coal and fuel oil for boilers, boiler operation, types and characteristics of boilers, and recent practice in boiler operation.

A. S. A. E. and Related Engineering Activities

Walker Assumes Duties of President

IN accordance with the provision of the Constitution of the Society H. B. Walker, professor of agricultural engineering, and head of the department, at Kansas State Agricultural College, who was elected first vice-president at the last election, automatically assumes the office of president of the American Society of Agricultural Engineers on the passing of President Ives.

Prof. Walker is a graduate of Iowa State College and has specialized in the drainage and irrigation branches of agricultural engineering. He has served as topographer for the Chicago, Burlington & Quincy Railroad; assistant drainage engineer of Humbolt County, Iowa; extension drainage and irrigation engineer for the Kansas State Agricultural College; and from June 1917 to date he has served as engineer and member of the Kansas Water Commission. From September 1917 to July 1919 Prof. Walker served as a captain of engineers with the 78th Division of the U. S. Army, and in the A. E. F. as assistant division engineer on engineering operations.

In connection with A. S. A. E. activities, Prof. Walker has served on the Committee on Land Colonization, Committee on Aims and Objectives of the Agricultural Engineering Curriculum, and as chairman of the Committee on Farm Sanitation and the Committee on Cooperative Relations of the College Division.

In the capacity of chairman of the Committee on Cooperative Relations, Prof. Walker has been largely responsible for a development in conjunction with a similar committee appointed by the National Association of Farm Equipment Manufacturers, which has most interesting and significant possibilities for both the farm-equipment industry and the agricultural-engineering profession. The program of work which this committee is getting under way is creating widespread interest and attention.

The Society is particularly fortunate in having a man of Prof. Walker's standing and ability to fill the vacancy in the office of president created by the unfortunate and regrettable passing of Prof. Ives.

Cooperative Relations Committees Meet in Chicago

THE A. S. A. E. Committee on Cooperative Relations held a joint meeting with a similar committee from the National Association of Farm Equipment Manufacturers in Chicago, July 14. The Society was represented by H. B. Walker, chairman of the Committee, and Raymond Olney, secretary. The N. A. F. E. M. was represented by R. B. Lowrie, chairman of the association's committee, G .W. Iverson, F. A. Wirt, and H. J. Sameit, secretary of the association.

The greater part of the session was devoted to the outlining of a general plan for conducting tractor schools. The general outline agreed upon has been placed in the hands of a subcommittee to work out details.

The Committee also gave consideration to the problem of working out a plan for inducting graduates in agricultural engineering into the farm-equipment industry.

Widespread interest is being created in the activities of this joint committee. The A. S. A. E. committee, representing as it does the College Division of the Society, is concerned chiefly with increasing the effectiveness and scope of agricultural-engineering education, and also for finding openings for graduates in agricultural-engineering courses. The coordination of these efforts with those of the farm-equipment industry through the joint committees on cooperative relations is creating a better understanding between the farm-equipment industry and the educational institutions, the results of which will be most far-reaching and eminently satisfactory to all concerned.

Resolutions for Prof. Ives

AT a meeting of the executive committee of the National Association of Farm Equipment Manufacturers held in Chicago on July 10, the following resolution relative to the passing of Prof. F. W. Ives, who had just assumed office as president of the American Society of Agricultural Engineers, was unanimously adopted, for which sentiment the Society is sincerely grateful:

"WHEREAS, Our attention has just been called to the untimely death on July 5 of Prof. F. W. Ives of the Ohio State University, and president of the American Society of Agricultural Engineers, as the result of injuries sustained by him in a railroad wreck at Buda, Illinois, on June 30. Therefore, be it

"RESOLVED, That the Executive Committee of the National Association of Farm Equipment Manufacturers extend to the bereaved family, the Ohio State University, and the American Society of Agricultural Engineers their profound sympathy, and Be It Further

"RESOLVED, That this resolution be incorporated in the minutes of this meeting, and that copies of same be sent to the family of the deceased and the two organizations referred to."

Model Reclamation Project

FOR the purpose of putting government reclamation projects, particularly irrigation developments, on a strictly business basis in the future, Dr. Elwood Mead, chief of the Reclamation Bureau of the U. S. Department of the Interior, has instituted a general investigation of the problems in connection with the construction of the Spanish Springs (Nevada) project. In other words, Spanish Springs is to be planned as a model project, to serve as a basis for future reclamation work throughout the United States.

On the recommendation of Dr. Mead, Secretary of the Interior Hubert Work appointed David Weeks, research specialist in the department of agriculture at the University of California, as consulting engineer and chairman of the special investigating committee for the study of the Spanish Springs project. Other members of the committee are Robert Stewart, dean of the college of agriculture, University of Nevada; A. C. Cooley, director of agricultural extension in reclamation projects; C. W. Creel, director of agricultural extension, University of Nevada; and J. F. Richardson, project manager, Newlands Reclamation Project.

Never before in the history of the U. S. Reclamation Service have estimates of cost gone beyond the point of finding out what the probable cost of storage works and main canals might be, but on this work the committee is estimating the cost of the complete agricultural development, which in the words of Chairman Weeks "is an agricultural-engineering problem pure and simple." Briefly, the committee's report to the U. S. Reclamation Bureau will cover the following:

(1) The area of first-class land suitable for irrigation on which full project costs can be paid.

(2) The area of land belonging to a lower classification not able to pay full project costs.

(3) The approximate amount of water required for growing agricultural crops.

(4) The area that will probably need to be drained and the probable cost of such drainage.

(5) The character of agriculture and the kind of crops suited to that area and the amount of project costs settlers can pay on fully developed farms.

(6) The proper size of farm units and the cost of improving and equipping such farm units.

(7) Recommendations as to what assistance can and should be given to settlers in the development of their farms to enable them to meet their obligations to the government and make this a solvent and successful undertaking.

The finished report, which will be presented to Congress, will contain special reports by subcommittees on the various phases of the investigation, and in addition to the conclusions and general recommendations of the main committee. These subcommittees include soils and land reclamation; duty of water and drainage; agricultural adaptation, estimated income and cost of production; prices, markets and transportation; credit facilities; the irrigation system; ex-service men and land settlement; the relation of the Swingle and Fernley Bench lands to the Spanish Springs Project; and land leveling and clearing.

The Committee completed its investigations August 1, and the report which is to be submitted to the Bureau of Reclamation and finally to Congress is now in process of preparation.

Agricultural Engineering Research in England

THE British Ministry of Agriculture announces that Oxford University has accepted their proposal to set up a separate research institute in agricultural engineering, with Capt. B. J. Owen as director of the new institute. The effect of this will be that complete continuity of work on research problems in agricultural engineering will be secured, notwithstanding the transfer of such research from the Ministry to Oxford, since Capt. Owen has for some time taken an important part in connection with the Ministry's farm machinery research.

While the responsibility for research and investigation will be transferred to Oxford University the Ministry of Agriculture proposes itself to inaugurate a scheme for the testing of agricultural machinery. It proposes that tests shall be carried out and certificates issued on its authority, but that the actual work of testing shall be conducted by the new research institute at Oxford, the National Physical Laboratory, and other institutions. It is expected that the testing scheme can be made self-supporting, and that fees will be charged on this basis.

Minnesota Land Clearing Demonstrations

THE "Minnesota Special," a land clearing, crops and livestock-feeding train from the University of Minnesota, gave sixteen demonstrations in thirteen northern cut-over counties of Minnesota between the dates of June 9 and July 4.

In these demonstrations the use of war explosives, stump pullers, breaking plows, and tractors were demonstrated. The definite goal of each demonstration was to clear the land of stumps and stones, plow it, and otherwise make it ready for planting a crop of some kind. An average of about two acres was cleared and plowed at each stop.

The following companies furnished equipment and operators for conducting the demonstrations: Deere & Company, Ford Motor Company, J. I. Case Threshing Machine Company, Oliver Chilled Plow Works, Schurmeier-Whitney Company, Anderson Wagon Company, and Kohler Company. While the train was operated under the auspices of the University of Minnesota, all the chief items of expense were paid by the railroad and the farm-equipment companies.

In a large baggage car were featured land clearing, livestock feeding, crop improvement, farm buildings, and forestry exhibits, a particularly interesting feature of which was a model of a homemade silo showing the utilization of the by-products of land clearing.

The train was in general charge of A. J. Schwantes, land clearing specialist of the University of Minnesota, assisted by Prof. Wm. Boss, chief of the division of agricultural engineering, and M. J. Thompson of the Duluth station.

Administration of American Lumber Standards Begins

THE National Lumber Manufacturers Association has announced the establishment by the association of a Lumber Standards Bureau "to promote uniformity and maintenance of grading and inspection of lumber," as authorized by the general lumber standards conference held in Washington, April 23 last.

According to the announcement, the manufacturers association have, without important exceptions, incorporated or agreed to incorporate in their fficial rules and practice the standard sizes, grades, namenclature, and basic grade classifications adopted by the general conference of lumber manufacturers, distributors, and consumers approved by the U. S. Forest Service and recommended by the U. S. Department of Commerce. This marks progress towards national lumber standardization much beyond all reasonable expectation two years ago. Lumber manufacturers are now almost universally offering "American Standard" lumber. It is hoped that the organized support of these standards by lumber distributors and consumers may be promptly developed.

The lumber industry has never gone before the public with any movement fundamentally more constructive or more promising of benefit to producers, distributors, and consumers alike than in this project of the establishment and maintenance of national standards for lumber. Among basic American industries it has set standards for lumber.

Authur T. Upson, former chief of the section of industrial investigation of the U. S. Forest Products Laboratory, was engaged by the N. L. M. A. some time ago as lumber standards advisor to the newly established bureau of lumber standards. His work will consist largely of conferring with manufacturers and with their regional organizations in regard to promoting the general introduction of American Lumber Standards and assisting them to deal with the many practical problems that are likely to arise in connection therewith. His immediate duties involve direct assistance to the regional associations in the final formulation of grading rules for American standard lumber and structural timbers, and definitions of defects, blemishes, etc., which are to be submitted by the Central Committee on Lumber Standards to a general conference to be held May 1, 1925.

The preparation of a handbook of standard lumber purchase specifications, approved by the manufacturers standardization committee and authorized by the Central Committee on Lumber Standards will be developed under Mr. Upson's direction. His work will be greatly faciliated by the cooperation of the Simplified Practice Division of the U. S. Department of Commerce, which will issue in the latter part of August, in its Bulletin No. 16, a complete copy of American Lumber Standards, as formally adopted at national conferences of all concerned in December 1923 and May 1924.

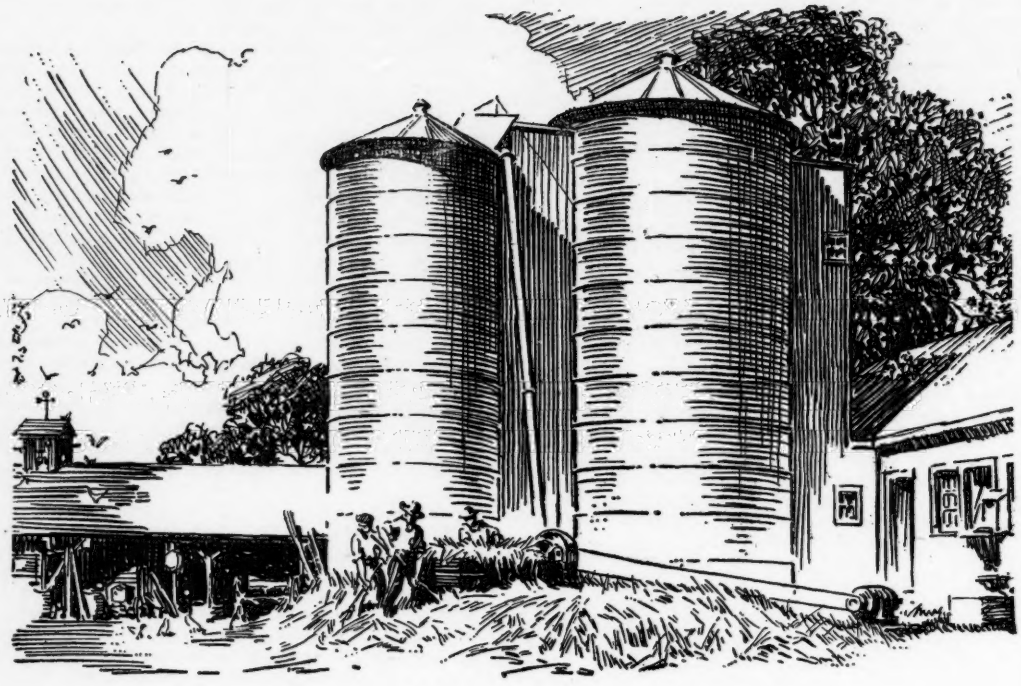
North Carolina Drainage Association Meets

THE fourteenth annual convention of the North Carolina Drainage Association was held at Belhaven, April 29 and 30. The meeting was called to order by Fred P. Latham, president. The delegates were welcomed by one of Belhaven's leading citizens, which was responded to by Walter F. Cohoon, Elizabeth City. The president then delivered the address of the evening, expressing his keen interest in drainage, the upbuilding of the Association, and the welfare of the state of North Carolina.

The first part of the meeting on April 30 was taken up with the election of officers and appointment of committees. Fred P. Latham was re-elected president, B. M. Potter was

(Continued on page 192)

Studying the Problem



IF electric energy can take the place of animals now fed with the produce of several acres what is the gain to the farmer?

If it is possible to increase the production per man per acre, what is the cost in kilowatts and new equipment?

If electric energy can do the work of human muscles, how many hired hands can it displace, and what is the cost of the displacement to the farmer?

NATIONAL ELECTRIC

# of Farm Electrification

These are typical questions that must be answered before it is feasible to electrify many of the six million farms still without electric service.

The problem of rural electrification is not one that electrical engineers can solve unaided. They must have the practical guidance of agricultural engineers—of men who can indicate uses of electric energy which will be profitable to the farmer and the lines along which farming must be developed in order that electricity may play in agriculture the part that it has long played in industry.

Hence the state groups in charge of the work invariably include agricultural engineers who are members of the faculties of state agricultural colleges.

In Minnesota, South Dakota, Alabama, and Kansas, groups of farmers are already being supplied with electricity experimentally. The state agricultural college participates in the experiments conducted by each group. Thus the National Committee is assured of competent technical support and of accurate records of energy consumption, cost, time and labor.

The National Committee referred to is composed of economists and engineers representing the American Farm Bureau Federation, the Department of Agriculture, the Department of the Interior, the Department of Commerce, the Power Farming Association of America, the American Society of Agricultural Engineers, and the National Electric Light Association.

A booklet has been published by the National Committee. Read it and pass it along to your neighbor. It will be sent free of charge. Write for it either to Dr. E. A. White, the American Farm Bureau Federation, 58 East Washington Street, Chicago, Ill., or the National Electric Light Association, at 29 West 39th Street, New York City.

LIGHT ASSOCIATION

re-elected secretary and treasurer. The various committees for the following term were appointed by the president. After the business a very interesting group of speakers gave the convention food for thought. The morning program was as follows:

"Engineering Features of a Successful Drainage Project"—W. D. Alexander, C. E., Charlotte, North Carolina.

"State and Federal Cooperation in Promotion of Successful Drainage"—Brent S. Drane, director, North Carolina Geological and Economic Survey, Chapel Hill, North Carolina.

"The Operation of the State Drainage Law Under the State Highway Act"—Walter F. Cohoon, chief counsel, North Carolina Highway Commission, Elizabeth City, North Carolina.

"The Economic Need of More Cultivated Land"—Gen. E. F. Glenn, member, North Carolina Land Settlement Commission, Raleigh, North Carolina.

"Sanitation and Drainage"—Col. F. E. Longley, sanitary engineer, International Health Institute, New York.

These most helpful and inspiring lectures were followed by a few informal talks by men interested in and directly connected with drainage work. The meeting adjourned until after lunch, and then an automobile tour of inspection was made over a successful drainage project at Tera Sea.

Personals

S. P. Lyle has resigned as head of the agricultural engineering department of the State Agricultural School at Jonesboro, Arkansas, to accept the position of professor and head of the division of agricultural engineering at the University of Georgia, succeeding W. A. Foster.

New A. S. A. E. Members

Dudley T. Angas, wheat farmer, Hill River, Clare, South Australia.

William A. Forbes, Pacific Coast manager, Potash Importing Corporation of America, San Francisco, California.

TRANSFER OF GRADE

U. S. Allison, Bishop, Texas. (From Student to Junior Member.)

M. B. Barnett, McKinney, Texas. (From Student to Junior Member.)

M. A. Bengston, Oakland, Nebraska. ..(From Student to Junior Member.)

Deane G. Carter, head of department of agricultural engineering, University of Arkansas, Fayetteville, Arkansas. (From Associate Member to Member.)

E. H. Gohmert, stock cleark, International Harvester Company, Houston, Texas. (From Student to Junior Member.)

C. F. Gorman, Winnsboro, Texas. (From Student to Junior Member.)

H. O. Roberts, Jr., Terrell, Texas. (From Student to Junior Member.)

W. H. Willis, Bryan, Texas. (From Student to Junior Member.)

Applicants for Membership

The following is a list of applicants for membership received since the publication of the July issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to applicants for the consideration of the Council prior to election.

John J. Koodriaftseff, draftsman, Standard Steel Car Company, Butler, Pennsylvania.

George C. Kreutzer, director of farm economics, Bureau of Reclamation, Department of Interior, Wilda Building, Denver, Colorado.

E. Grant Lantz, Omaha National Bank, Omaha, Nebraska.

TRANSFER OF GRADE

Richard C. Miller, assistant professor of agricultural engineering, North Dakota Agricultural College, Fargo, North Dakota. (From Junior Member to Member.)

Directory of Professional Agricultural Engineers

CLARK E. JACOBY ENGINEERING COMPANY
Consulting Engineers
Drainage, Land Reclamation, River and Flood Control, Tiling, Topographic Surveys, Bridges and Reinforced Concrete Structures
Interstate Building, Kansas City, Missouri

STANLEY F. MORSE
Mem. A. S. A. E. Consulting Agricultural Engineer
Land Examinations, Reports, Development Plans and Estimates. Farm Inspections, Supervision, Management. Drainage, Irrigation, Livestock, Fruit Growing, Forestry. Tropical Agriculture. Spanish Spoken.
MORSE AGRICULTURAL SERVICE
133 Front Street, New York City

HARVEY R. BURR
Consulting Agricultural Engineer
Formerly director of agriculture at Williamson Trade School, Pennsylvania
Landscape Gardening—Farm Buildings—Canning Factories
Soils—Livestock—Farm Machinery—Water Power
Marketing—Farm Management
Waunakee, Dane County, Wisconsin

KURT GRUNWALD
Consulting Agricultural Engineer
Investigations and reports covering crop adaptability in arid and humid regions, potential sugar beet production, irrigation and drainage problems, appraisals on land, supervision of farms and ranches, and selection of livestock breeds.
Medford, Long Island, New York

Agricultural Engineers Should Advertise

The time is ripe for agricultural engineers to build up a consulting practice. The demand for their services is growing, and those who advertise now will be the first to reap the harvest. Rates for professional cards like the above—size 1 by 3 inches—are as follows:

To A. S. A. E. members: $2.00 per insertion for 12 consecutive insertions or more; $3.00 per insertion for less than 12 consecutive insertions.

To non-members: $4.00 per insertion for 12 insertions or more; $6.00 per insertion for less than 12 consecutive insertions.

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, 1923 graduate of Kansas State Agricultural College in agricultural engineering, desires to make a change. Work along engineering lines is preferred. Address M. S. Cook, 5406 Ferdinand Street, Chicago, Illinois. MA-121.

AGRICULTURAL ENGINEER with experience on large farms with all kinds of machinery and equipment wants position with manufacturer of farm equipment. MA-122.

AGRICULTURAL ENGINEER wants position with contractors doing work in farmstead planning and building. MA-123.